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Editor
Fred R. Low
Associate Editors
C. H. Berry
A. D. Blake

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Herbert Hoover—Engineer

FOR the second time in the history of the country an engineer has been nominated for President of the United States. And there is need, in the administration of our national housekeeping, for the engineering type of management and thinking.

Research, discovery and invention have made necessities of products and services unknown to even recent generations. Improved means of communication, transportation and distribution have led to the centralizing and nationalization of businesses and industries formerly sectional or local in character and extent.

The present civilization is the product of engineering, and it needs the analytical, positive methods of the engineering mind more than those of the elastic legal conscience to fit its factors into a progressive social-economic structure. An engineering question is as capable of a positive answer as is a mathematical problem, the essential quantities and conditions being given in each case.

True, engineers may be found who will hold briefs for conflicting contentions, but when the experiences, preferences and motives that actuate them are examined and reduced to a fact, a sound solution is inescapable.

Herbert Hoover has won high honors as an engineer. He is sanely progressive. He owes his preferment to nobody or nothing but demonstrated ability and big achievement. He will jump at the crack of no man's whip and not be afraid to rock the boat when Rooseveltian action is needed, and his nomination is a manifestation that, in the minds of the people, the engineer is coming into his own.

F. R. Low

What Is a Refractory?

THE tendency away from refractory-lined boiler furnaces, toward the water wall, may be considered as either a definite forward step in design practice or a temporary expedient to meet a condition. Time only will tell which is the correct view, but meanwhile, it is profitable to ask whether refractories have yet reached their ultimate development.

So far as the boiler furnace is concerned, it must be said that, after even a cursory study, there is much improvement in refractories still to be expected. One of the factors that seem to have held back this development is the fact that the engineer has never yet given the ceramist a full specification for the material desired. It is quite impossible for a laboratory worker, lacking, as he does, familiarity with boiler operation, to be aware of the service requirements of a refractory to meet a given set of conditions. He must be given a full explanation of the properties desired with reasons for their necessity. He then will be in a position to develop scientifically the desired product. Otherwise, his work will be reduced to the status of cut and try.

This means that the engineer should ask himself what a refractory is and what it is expected to do under modern conditions. When these optimum properties have been determined and presented to the ceramic researcher, it is very probable, in the light of recent advances in the field, that a much more satisfactory material will soon be available.

Progress Through Accidents

THE manufacturer of a speed reducer or a clutch or a small pump can set up a specimen of his product during its development period and run it to death. This is common practice in the manufacture of small devices, to determine where they have weak spots and to work the design up to a measure of consistent sturdiness that will lead to commercial success for the manufacturer.

Unfortunately, the manufacturer of large power equipment cannot do this.

It is manifestly impossible to set up a 50,000-kw. steam turbine generator and run it under load for a prolonged period. As a matter of fact, as manufacturers are situated today, it is impossible to run it under load at all—it is not even possible to operate it under the steam conditions for which it is designed.

Accordingly, in the field of large power machinery, the customer is in a measure a partner of the manufacturer in the grand common enterprise of developing bigger and better power machinery. The manufacturer spends his money for research, designs as well as he can and stakes his reputation on the outcome. The customer pays the cost of the engineering and manufacturing expense incident to the building of the machine and assumes the risk of interruption to his generating service as his part of the venture.

Only so can progress be made. It is impossible, by thinking, to determine where and how and why so complicated a mechanism as a steam turbine will give trouble. That an untested design is likely to give trouble of some sort is pretty nearly certain. To minimize the likelihood of difficulty through refusal to accept innovations in design would lead to stagnation in accomplishment that would be a sad reflection on the enterprise of those engaged in generating power. It is really a splendid tribute to the pioneer spirit of the American engineer and business man that the power-generating companies enter heartily into this co-operative venture with the manufacturers of large equipment whereby such startling improvements have been made in past years in steam turbines and boilers and their accessory equipment.

Accidents and difficulties should not be thought of in terms of opprobrium for the manufacturer, but should rather be regarded as inevitable and ultimately useful, albeit painful, steps in the progress of the art that means so much to everybody in and out of the business of power generation.

Pin It Down

WHAT are meters for? Foolish question—to measure with, of course. But the question is not so foolish as it sounds. A real answer compels thinking, and thinking is generally a profitable occupation.

Only recently the statement was made by an experienced engineer that departmental metering of steam, water and electricity was not necessary in his process plant, as all the work in the plant went into a single product. Hence, he said, correct division of cost between departments was not important.

This engineer is quite right as far as knowing the total cost of the product is concerned. What he overlooks is the fact that the total cost is the sum of its parts and that only a constant guard kept on the parts can keep the total down where it ought be.

To make this clearer, picture a small plant turning out one thousand units per month of a single product at a total cost of ten thousand dollars, or ten dollars per unit. Let us say that there are ten departments in all.

First assume that there are no departmental steam meters, although every department uses steam. The foreman of department *A* is careless and runs up the steam bill one hundred dollars. Department *B* is careful and saves one hundred dollars on steam. The two cancel and the management sleeps on, dreaming that all is well. Foreman *A* gets no blame and foreman *B* no credit.

If meters had been installed foreman *B* would have been complimented on his showing and given a real incentive to keep it up. And foreman *A* would have been pulled back into line. The man who can't get excited over a one per cent increase in the total operating cost of the plant (particularly when he knows he won't get blamed for it) will do some tall hustling when the same actual sum is chalked up as a ten per cent increase in the cost of operating his own department.

It's all very well to know *what* the cost is, but you can't get far if you don't know *where*. And you can't know *where* without departmental meters.

Wet Steam in Turbines

ENGINEERS found quite early in the development of steam turbines that the use of superheated steam resulted in greater gains in economy than was represented by the proportionate increase in the heat available to do work. Many explanations were offered to account for this gain. A few years ago it was shown that the efficiency of the superheat section of a steam turbine was about ten per cent greater than that of the saturated section. Still later it became evident that the stage efficiency of the saturated section of steam turbines decreased with increase in the wetness of the steam.

Various theories were advanced to account for this phenomenon. While these were interesting from a theoretical point of view, the turbine user desired the development of means whereby the difficulty could be diminished or eliminated entirely.

One of the early devices for diminishing the effect of wetness in the low-pressure steam, was the adoption of the bleeder cycle. This resulted in less steam having to pass through the low-pressure stages to the condenser for a given generator output than with no bleeding. Hence the relative effect of wetness on over-all efficiency was lessened.

Theories have recently been developed that indicate that the lessening of the efficiency of the low-pressure stages is due to the fact that the water particles and the steam in their passage through nozzles and blades, do not travel at the same velocity. Some of the available energy from the steam appears to be lost in accelerating the water particles. If the water droplets could be separated from the steam and removed from the turbine, the deterrent element would be eliminated. This has been the idea of designers in proposing various plans to draw off this water at the bleeder points. Such methods appear to have been only partly successful owing to the difficulty of separating the water droplets from the steam when in a fog-like condition. A European turbine builder has recently patented a plan that provides a series of small water bypass openings at the base of the nozzle or stationary blade elements which discharge the water beyond the blade tips. This is said to have shown a marked increase in efficiency on test.

There is no doubt that the efficiency of the saturated sections of steam turbines can be improved by an intensive study of the problems of handling wet steam at high velocities.

Industrial Plant Remedies Applied in the Power House

MOTORS for power-house applications require a wide range of characteristics to meet the requirements of the various drives. This is evident from a reading of the article "Selection of Motors for Power-House Auxiliaries" in this issue. The present trend is toward the use of alternating-current motors, except on some drives where large speed adjustments are required.

For constant-speed service the squirrel-cage motor is generally used. Permitting direct switching across the line at starting, it combines the simplest type of control with a high degree of reliability. Where large slow-speed motors are required, the modern synchronous type has many advantages. It can start pump and fans satisfactorily under load and can be started by direct connection across the line.

On essential auxiliaries it is often the practice to install oversize motors. When induction-type motors are used, this excess capacity becomes a detriment to the system load in the form of low power factor. Over-capacity in the synchronous motor, on the other hand, can be made to earn its way by correcting the power factor of the system and thereby releasing generator capacity.

When alternating generators to supply power to auxiliary motors are designed for power factors as low as six-tenths, it is evident that the power factor of the auxiliary load calls for improvement. Serious objection would be raised against an industrial power load having such a low power factor. The power house should set a good example by correcting the power factor of the auxiliary load and applying other remedies.

In most applications where speed adjustments are required, the alternating-current motor is at a disadvantage. Yet all kinds of complications have been tolerated by plant designers and operators to avoid using direct-current motors. In industrial-plant adjustable-speed applications a similar condition existed a few years ago. This, however, has given way to the use of direct current for many applications. Here again the power house might take a leaf from the industrial engineer's book.

Bring Aid to the Metallurgist

BOILER operators and designers are accustomed to go to the metallurgist with two types of problems. In cases of failure of metallic parts the cause is sought so that the trouble can be avoided in the future. And in new developments, such as the use of higher temperatures, help is asked for in selecting metals that will stand up under the changed conditions.

The solution of these problems is undoubtedly one of the functions of the metallurgist, but he cannot hope to give as good service as is expected unless he meets with more effective co-operation from the engineer. What is needed is detailed information about parts that have failed and have stood up in service similar to that to be encountered by the metals he is to study. Such data will help in two ways.

In the case of a part that has failed, if the facts concerning its service and the service of other similar parts are available, experimental work to determine the cause of the failure is greatly shortened, for all the preliminary work necessary to reproduce the conditions of operation is obviated. The laboratory, being supplied with the broken part and the data concerning the break, can determine in a few hours what otherwise might take weeks to find out.

New developments will involve new conditions, and the metallurgist should be informed fully as to what these are. Also, he should be given access to all information available as to the performance of metals under conditions approaching the new set as nearly as has been yet attained. These facts are likely to spell the difference between success and failure in his work.

And, in general, engineers should include data in their papers, reports and published discussions that will be of service to metallurgists. By building up in this way a factual background for future tests and experiments, the satisfactory solution of metallurgical research problems affecting power equipment will be greatly advanced.

Welding Moves On

IT BECOMES more apparent every day that welding is a major tool of construction, production and maintenance. While the proponents of the various processes argue their relative merits, the engineer user is impressed most with the almost infinite applicability of welding in one form or another.

Disinterested observers find the arc best suited for certain applications, gas for others and resistance for still others.

There are certain fields where the best process is a matter of opinion, but it is folly to fight over these, while neglecting the potential applications that lie on every hand.

Power house is supported on piers resting on the roof of the waterwheel pits in the dam

HYDRO-ELECTRIC PLANT
Built on High Piers

By L. F. Harza
Consulting Engineer, Chicago, Ill.

Four miles distant and operating in water synchronism with Dix River Station, the new 2,000-kw. hydro station at Dam No. 7 on the Kentucky River, makes available additional 15-ft. head. Three generating units and auxiliaries housed in low buildings mounted on high piers, with flat hatched roof served by traveling gantry crane. Automatic float control of propeller-type turbines provides for operation at gate opening giving best efficiency.

UNDER the War Department the Kentucky River has long been developed for navigation by the slack-water method. There are fourteen locks and dams controlling the navigation levels from Beattyville, Ky., to the mouth at Carrollton, a distance of about 250 miles and a total fall of 219 ft. Seven of the navigation dams are above the mouth of the Dix River and control a total fall of 123 ft. The other seven dams are below the mouth of this river and control a 96-ft. fall. The lower projects will have the benefit of the storage already created by the Dix River dam of the Kentucky Hydro-Electric Company and of additional storage that can ultimately be made available upon the upper forks of the Kentucky River. The upper projects will be run-of-river developments until the upper forks storage possibilities are developed. Lock and dam No. 7 are about one-half mile below the mouth of Dix River and about four miles below the Dix River station. The normal head at this dam is 15 ft., and because of its proximity to the Dix River station it is conveniently located for supervisory control and because the upper pool water of Dam No. 7 extends to the Dix River power house, it is also well situated for synchronous utilization of the water discharged by the Dix River station. For these reasons this site can serve readily as nearly the equivalent of 15 ft. increase in height of the Dix River dam. Water discharged by the Dix River units will be used simultaneously by the No. 7 station without appreciable lag. This station was therefore adopted as the first development on the Kentucky River to utilize the storage created by the Dix Dam.

Because of the short length of dam (340 ft.), which, with rising stage of the river, causes the No. 7 lock to be flooded out and incapacitated for navigation earlier than any other lock, it was not considered desirable to construct a conventional type of power house in this dam, thus shortening it by some 80 ft. or more. Moreover, a cliff rises from the end of the dam opposite the lock, precluding the economical construction of a power house beyond the present abutment. It was therefore decided to construct a power house within the existing length of the dam without reducing the effective length of the former spillway. To this end the hydraulic turbine pits were so constructed that their roofs are at the same elevation as the crest of the overflow spillway of the dam. The power house was then built on three concrete piers, centered over the waterwheels by arching over them from an upstream pier supporting

the trash racks, to a downstream pier supporting the lower side of the building.

These piers inclose the turbine shafts and protect them from damage from floating drift. They are 6 ft. thick, much less than the diameter of the generators. Since, the shafts of the turbines come up through the centers of the piers, the generators necessarily overhang and required that the building be provided with cantilevers at each end. This construction was carried still further in order to accommodate the switchboard and space for other auxiliaries.

Although No. 7 station is near a railroad, it had to be located at the end of the dam opposite from the navigation lock, where it could not be reached by a highway constructed at reasonable cost. The station, therefore, was so designed as to facilitate the transfer of machinery by barge to the station for initial installation and to or from the station for subsequent purposes. To handle this machinery by a standard traveling crane would have required a cantilever runway for the crane at one end of the building to permit it to run out of the building over an attending barge. Therefore resort was had to the use of a gantry crane traveling on the roof of the power house and overhanging with cantilever ends, the forebay and tailrace, in order to handle machinery off a barge and place it into the power house through a hatch in the roof. This design greatly reduced the required height of the building.

Turbine Pit Deck Acts as Spillway

The roof or deck of the turbine pit acts as a portion of the spillway of the dam. The thickness of the piers is much less than the diameter of the pit liners of the turbine. For this reason an archway is provided in the piers spanning the pit liner in an upstream and downstream direction, and the segmental top of the pit liner and sides of the archway are covered by steel-plate removable covers which, when removed, permit lifting each turbine runner and its section of shaft upward until the bottom of the turbine runner clears the elevation of the deck or roof of the wheelpit, and then moving the runner and shaft sideways out onto this deck. To protect this spillway deck from overflow while assembling or dismantling machinery, a single pair of headgates sufficient to close off the water from one unit at a time were made six feet higher than the depth of the wheelpit, thus extending upward six feet above the crest of the spillway and diverting water from the deck, which is in use for installing or dismantling equipment. These headgates are of the Broome caterpillar type and, when not in use for closing off the supply to a unit, are placed in horizontal position across the top of the piers upstream from the power house by means of the gantry crane. The crane is equipped also with a rake for clearing the trash racks.

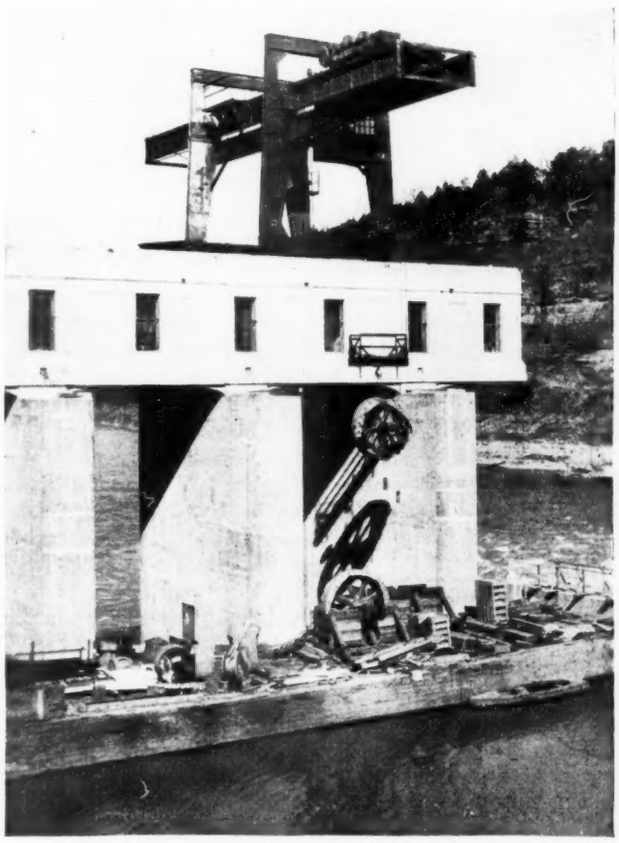
Automatic control of the plant is provided by floats, superseded when desirable by supervisory control over telephone circuit from Dix River station, about four miles away. For the reason that the hydraulic turbines are of the high-speed propeller type, with consequent low part-load efficiency and the units are small in proportion to the system load, the control was so arranged that each unit will run normally at the gate opening giving the best efficiency or not at all. In other words, whenever a unit is brought into operation by the float or by supervisory control, it will open to the point of best efficiency, which can be set by the operator for varying heads, and will maintain that gate opening until shut down altogether. This will be done by setting the governors to operate at slightly higher than system frequency, thus holding the gates always against the gate limit stop, but permitting the governor to close them in case of interruption of load.

As the headwater level rises, the three units will cut in consecutively at predetermined increases in head, which can be adjusted, and the order of doing so as between the three units can be altered at will by the operator or by the attendant on the occasion of any visit to the station. In the event of a rise of the headwater above what can be utilized by the turbines at normal gate openings, the gate limit stop on the governors is automatically released, allowing the turbines to open to full-gate position for maximum use of the surplus waters.

Generating equipment aggregates 2,000 kw. capacity, divided into three units. The generators were furnished by the General Electric Company; hydraulic turbines by the Newport News Shipbuilding & Dry Dock Company; governors by the Woodward Governor Company; the gantry crane and headgates by Phillips & Davies; the switchboard and all control equipment by the Westinghouse Electric & Manufacturing Company; transformers by the Pittsburgh Transformer Company, and the substation structure by the Delta-Star Electric Company.

The station was constructed under the executive control of Martin J. Insull, president, and G. W. Hamilton, vice-president, of the Middle West Utilities Company, and L. B. Herrington, president, and G. T. Bogard, vice-president, of the Kentucky Hydro-Electric Company. The design and engineering supervision of construction was in charge of L. F. Harza and organization, consulting engineers, of Chicago, and the project was constructed by the L. E. Myers Company, contractors, of Chicago.

A gantry crane on the power house roof is provided to handle the machinery



STABILIZING LOW-PRESSURE STEAM SAVES MONEY *In a Paper Mill*

By Donald Ross-Ross

THE steam problems of a mill making high-grade papers are not altogether similar to those confronted by a newsprint mill. Uniformity of product of the latter type of mill leads to more or less uniformity of steaming conditions. This statement is not intended to include conditions brought about by a

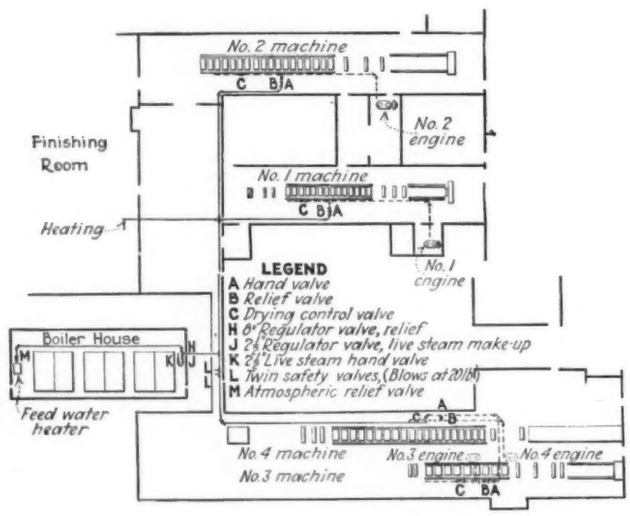


Fig. 1—Interconnected steam-header layout

pulp mill that might form part of the entire plant unit, but is solely confined to the paper-mill end.

Uniformity of steaming conditions does not exist to any extent in paper mills manufacturing high-grade papers, especially where the product is particularly diversified. The various grades and the various weights at which the grades may be run, require different amounts of steam for drying. The horsepower required to drive the paper machine varies with the speed of the machine, increasing with the higher speeds and decreasing with the lower. This means that the steam consumption of the engines will be different for each grade and weight of paper run, because the machine speed is set to suit the particular paper being made.

To illustrate how diversified the steaming conditions of a paper machine may be, one must consider that it is often necessary to run a machine slowly on a sheet that may be fairly heavy and give a good tonnage for the day. In such a case the drying steam demand is high and the steam consumption of the engine is relatively low, possibly necessitating live-steam makeup for drying. Again, the sheet might be a light one, being run at a fairly high speed, but giving low tonnage per day. This means that the engine is using more steam and the paper machine less, or a state may thus exist where the exhaust from the engine is in excess of drying requirements. The result is likely to mean a loss to atmosphere of the surplus exhaust steam.

The operation of the drying control, alternately shutting off and admitting steam to the paper driers, throws steam to waste at times and puts a demand on live-steam makeup at other times. It is assumed that the exhaust from the engine is practically constant, and when the drying steam falls below the average value, steam is

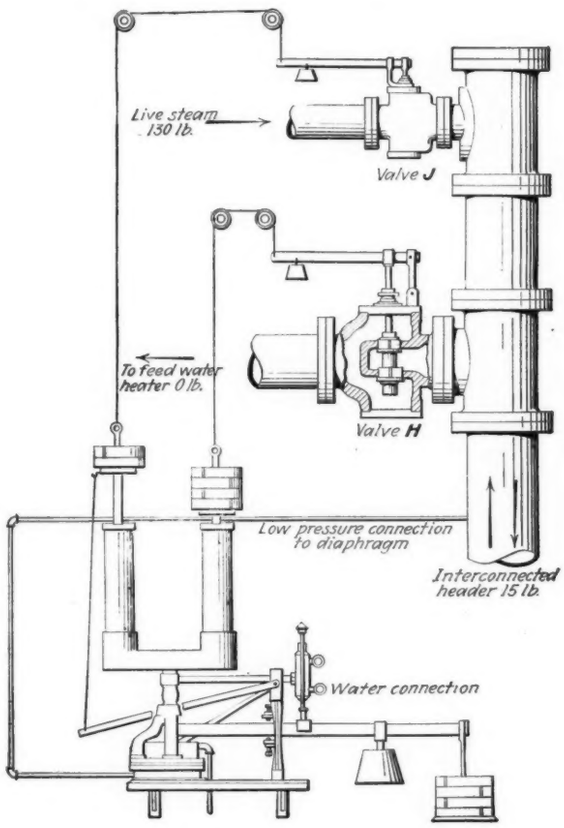


Fig. 2—Diagram of the main control in the boiler house

exhausted to the atmosphere, and when it rises above it there is a call for live-steam makeup.

There is also the loss of steam that occurs when the machine drying steam is shut off during washing up, changing of felts, breaks, etc., which should be considered.

The thought likely to occur to one at first, is to pipe

all the exhaust waste steam back to the feed-water heater and thereby make a saving.

Even with a pulp mill being carried by the same boiler plant as the paper mill, the raw-water makeup is not sufficient to utilize all the steam which may at times be blown back to it.

The problem resolves down to putting the entire exhaust steam into such a form that it can be used not only for drying steam, but for such other low-pressure purposes as are required around the mill.

Engine Exhaust Joined Up to a Common Steam Line

In a specific instance, now to be considered, the first step was the joining up of all the engine exhausts to a common steam line which will be termed the interconnected steam header, Fig. 1. An 8-in. pipe line is used to join machines Nos. 1 and 2 to 3 and 4, with 6-in. branches to the engine exhausts of 2, 3 and 4, and a 5-in. to No. 1 engine exhaust.

Each connection has a hand valve and an outflowing weight-and-lever type relief valve. These connections were made on Sunday and no interference with production occurred. During the changes drying was done as in the past.

From the header is also run an 8-in. pipe line to the feed-water heater, but intercepted by an 8-in. balanced valve. A $2\frac{1}{2}$-in. live-steam makeup line controlled by a balanced valve, joins ahead of this 8-in. valve. Both valves are operated by a double-motor hydraulic regulator, similar to what is used for controlling exhaust steam and live-steam makeup to paper machines. The apparatus is really intended to maintain a fixed pressure

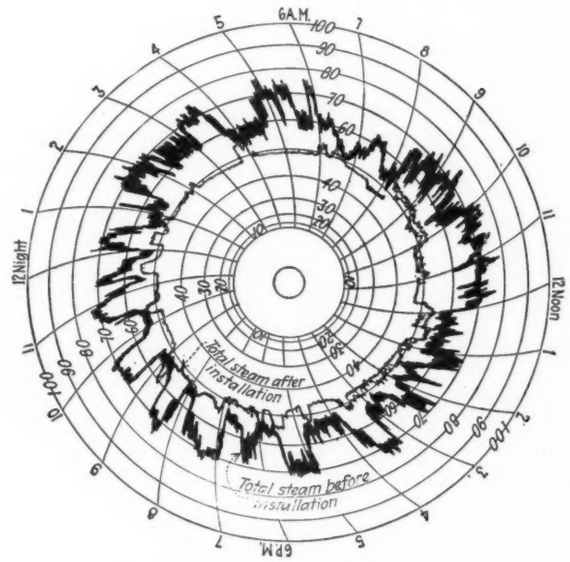


Fig. 3—Chart showing total steam before and after installation of interconnected header

in a paper machine, first, by opening or closing the valve admitting exhaust steam by means of the lightly weighted plunger, and secondly, admitting live steam through a live-steam makeup valve operated by the second plunger should the exhaust be not sufficient to maintain the pressure.

However, this is not exactly the way the regulator works in the present case. The diaphragm connection is made to the header side of both valves, and an increase in pressure causes the plungers to rise, one after the other. The heavier weighted plunger is connected to the 8-in. valve so as to shut the valve when it is at the bottom of its stroke and leave it wide open at the top of its stroke. The makeup valve is connected conversely to this, and is closed with the second plunger at the top and open with the second plunger at the bottom of its stroke (Fig. 2).

The result is that, when the beam of the regulator

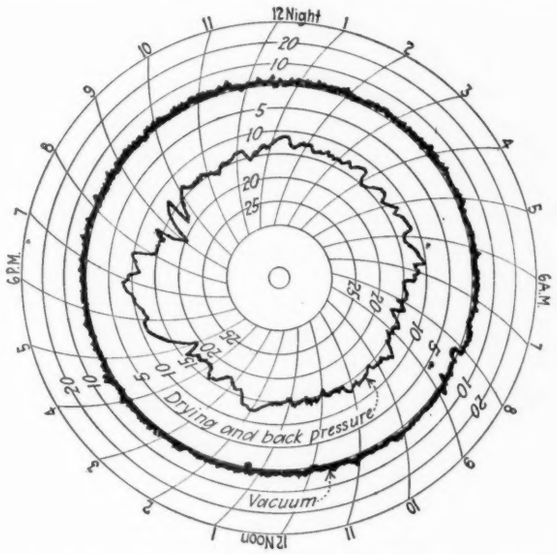


Fig. 4—Irregular pressure before installation of header

is properly weighted to a desired pressure of, say, 15 lb., the regulator will exhaust steam to the heater when the pressure rises a few ounces and will admit live steam when the pressure falls a few ounces from the average pressure.

This arrangement accomplishes three desirable results: First, the engines have a constant back pressure which improves their speed regulation. This, in itself, is an important feature. Secondly, steam that might be wasted by one machine is either used by another or goes to heat the feed water, and the net result is a smoother steam demand by the paper mill, as shown by the steam-flow charts, Fig. 3. Thirdly, the supply of drying steam being at a constant pressure, permits of better results by the steam controls on the paper machines. The drying charts (Figs. 4 and 5) illustrate this. This is also important where certain sheets are required to have a moisture content of a desired amount.

Original Hookup Method

Fig. 6 illustrates the method of hookup to each machine at the time of original installation and the alterations made as will be pointed out later.

The valve *A* is an ordinary stop valve placed between the main header and the engine exhaust to permit of repairs to the steam lines of the machine without closing down the whole system. Next to it, on the engine side, is a valve *B* of the weight-and-lever type, hooked open normally. This valve is arranged to open under pressure up to 20 lb. with no pressure in the header, or 5 lb. above the header pressure under normal conditions. The valve *B* is for two purposes.

Should the master controller in the boiler house go out of commission, it is only necessary to leave the 8-in. exhaust valve open and turn off the $2\frac{1}{2}$-in. stop valve

ahead of the live-steam makeup valve. This puts the interconnected header under atmospheric pressure and allows the excess steam from the machines to blow to the feed-water heater, or to the atmosphere. The machines are next cut off the header to maintain their own pressures by dropping valve *B*, which then acts only as a relieve valve. Exhaust from the engine is controlled by valve *C*, which would ordinarily control all the steam to the machines, and the live steam is added by valve *D* when necessary. *E* and *F* are hand valves to shut off the exhaust and live steam to the machines.

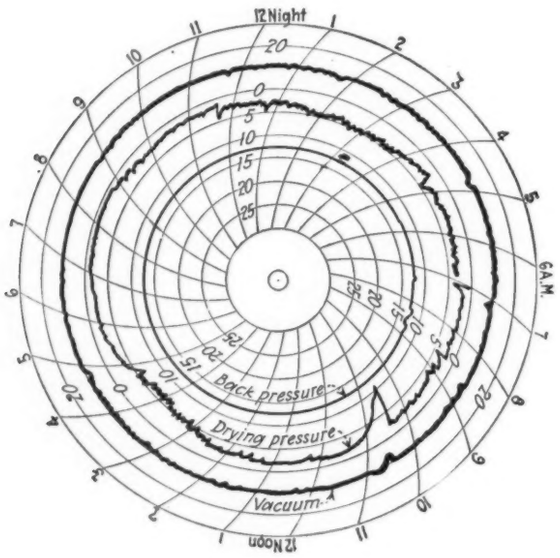


Fig. 5—More uniform pressure obtained after installation of header

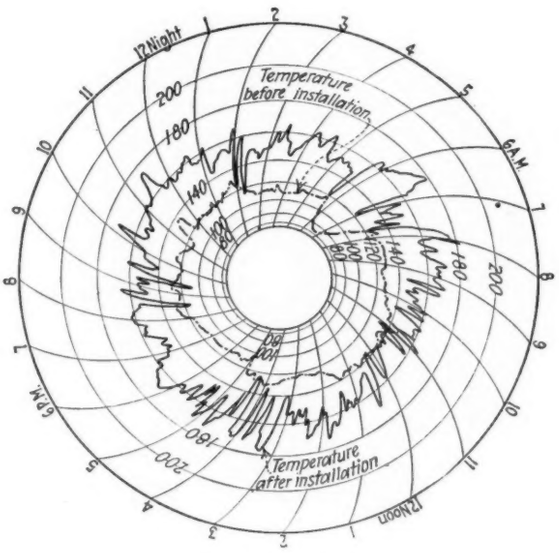


Fig. 7—Feed-water heater temperatures before and after installation

the roll will sag down, partly shutting off the pilot valve and, hence, the supplying of water going through it. To the piston rod is fixed a crossarm to which is attached on one side the rope (or chain) controlling valve *C*, and on the other side the rope controlling valve *D*. As the piston descends, it first opens valve *C* and then valve *D* (which operates if hand valve *F* is open). More steam is admitted, the pressure rises and the paper is dried.

If, on the other hand, the paper is inclined to be on the dry side, the piston is pushed upward by the greater

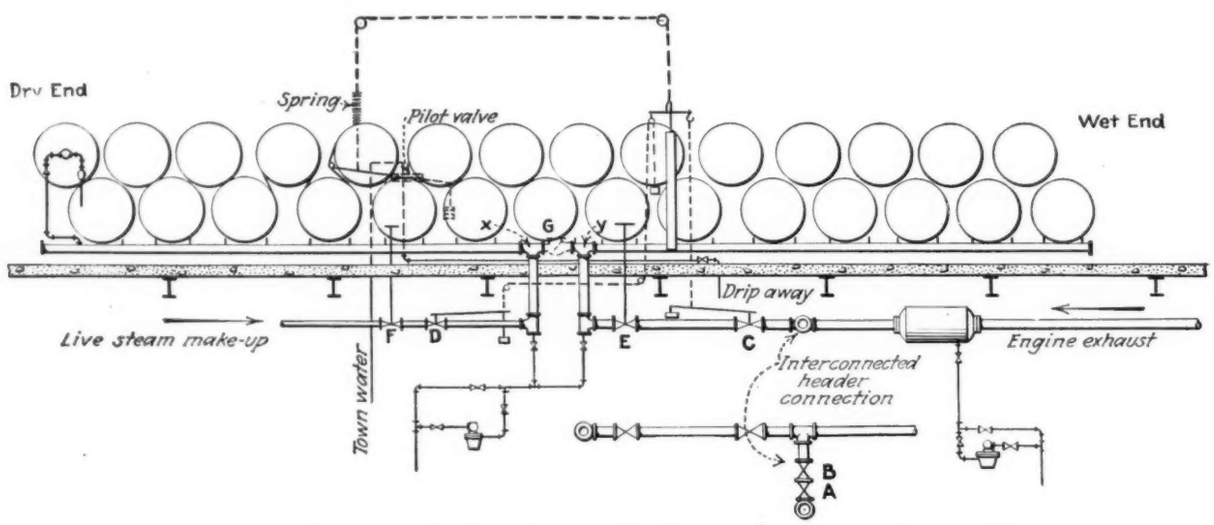


Fig. 6—Header connection to each machine and valve arrangement

A word about the particular drying controls on the machines should be made before proceeding further.

A roll of small diameter extends across the machine near the drier section in such a manner that it lies on the paper coming from the bottom drier to the top one, or vice versa. The paper is at an inclination to the vertical. The roll is held on levers at either side of the machine, one being made to operate a pilot valve of a regulator. When the sheet is wet, it lengthens out and flow of water allowed through the pilot valve. This movement closes off the valves.

Compensation to prevent hunting or overtravel is accomplished by a wire attached to the crossarm of the piston, which passes up over pulleys and down to a coil spring attached to one of the arms supporting the riding roller. As the piston goes down, the spring will pull up on the roll, which would be sagging owing to the damp paper. The more the piston goes down, the more

tension will be put on the roll to raise it, until a state of equilibrium exists. When the paper is dry, the reverse takes place.

Under normal working conditions the live-steam valve *F* is kept closed and the relief valve *B* hooked open. When valve *C* has been opened up by the drying control, steam flows into the paper machine header through it and the exhaust steam from the engine is supplemented, if necessary, by steam from the header to maintain the pressure up to the valve. As valve *C* shuts off, the exhaust steam which does not pass through it is forced out into the header. The even back pressure maintained against the engine is illustrated by the chart, Fig. 5. Considerable difficulty in maintaining a constant speed, on one of the engines particularly, was found before the back pressure improved, as shown. Variation of speed was found to take place, synchronizing chiefly with the back pressure and to a lesser extent with the line pressure. The latter difficulty was overcome later by raising the boiler pressure to 200 lb. and reducing it to 130 lb. on the engine lines by a combination reducing valve. This arrangement allows of a 60 lb. fluctuation of boiler pressure without disturbing the pressure to the engines.

Saves 1,100 Lb. of Steam Per Ton of Paper

The results obtained through the changes made in the header layout are of interest. Provision was made at installation for a lead-off for low-pressure steam heating. This was connected, later on, to the finishing room and warehouse building, which, under normal winter conditions, requires an average of 2,400 lb. of steam an hour.

Probably between 80 and 90 per cent of the time steam is relieved from the main header to the feed-water heater, and the rest of the time requires live-steam makeup through the 2½-in. regulating valve. This, of course, varies according to papers run and seasonal conditions. The steam consumptions of two particular days —one prior to cutting in the interconnected header and the other a month or so later—were 769,000 lb. and 589,000 lb. respectively. The productions on these days were 52.1 tons and 43.1 tons, or the steam per ton of paper made was 14,750 lb. and 13,650 lb.

Apart from this reduction excess steam was thrown back to the feed-water heater as shown by the temperature chart, Fig. 7.

The water fed to the boilers on these two days amounted to 1,800,000 lb. and 1,426,000 lb. with average temperatures of 121.5 and 157 deg. F. respectively. Conditions of steam consumptions between the pulp mill and paper mill were practically identical.

Change in Hookup

After a year's operation an improvement on the machine hookup was suggested. Two disadvantages were obvious in the original arrangement: First, the necessity of the machine tenders shifting valves when going into a hard drying sheet; secondly, when a sheet was drying just below the header pressure, there was no reserve should the sheet tend to become wet. The drying control would open wide and the pressure in the machine would rise to 15 lb. and no farther. Unless the back-end tender was watchful, he was likely to have the paper come over wet.

The change suggested made the entire system automatic. Fig. 6 shows the arrangement, which simply includes the addition of a check valve *G* between the connections *x* and *y* on the paper-machine drying header, so as to divide it into two sections. The exhaust and interconnected-header steam enters the wet-end section through the valve *C* and flows through the check valve *G* into the dry-end section under normal operating conditions. Should the paper not dry at 15 lb. pressure, the control will go down still farther and open the live steam valve *D*, admitting high-pressure steam to the dry end of the header. The pressure in this section closes the check valve and rises to any reasonable pressure (consistent with drier safety) until the paper dries. When the control shuts off the live steam, exhaust steam at pressures controlled by valve *C* once more enter the dry-end section.

This arrangement eliminates high and uneven back pressures coming on the engine under the previous arrangement and before the interconnected header was installed. Every time high back pressures occurred, on one engine in particular, there was trouble—speed variations and stopping of the engine—as it was working with its throttle pressure fairly close to line pressure.

The foregoing describes fairly completely the operation of the system as it exists. Some minor changes are likely to be made at the boiler-house end, to meet changes proposed in the feed-water system. Should an even temperature of 200 deg. F. or more be desired in these alterations, only slight changes will be necessary, without affecting the whole system.

In one plan under consideration it is proposed to heat the feed water with 15-lb. steam. This would mean shifting the 8-in. relief valve going to the heater into an atmospheric escape, leaving the interconnected header open right through, and eliminate entirely the atmospheric relief valve that now exists. This, of course, is contingent on an entirely new feed-water system.

How Much Steam in Your Tires?

Rubber tires are used so universally that their manufacture is becoming as important to the average man as the making of a motor car.

Power is entering more and more into this process and labor less and less. In the last ten years the production of tires per employee has increased over 400 per cent.

Just how the products of the power house are used in this industry will be told in an article on "How Power Services Help Make Rubber Tires," in POWER *for July 3, 1928.*

REMINISCENCES OF AN ENGINEER

By Hubert E. Collins

The Cable Car of Yesterday

CLANG! Clang! Clang! Came the sound of a gong on a lurching street car as it took the turns on "Dead Man's Curve" on Broadway, New York City, many times in every twenty-four hours while the old Broadway cable railroad was operating.

The car operator would pick up his cable at Sixteenth Street on the down trip, release the brake, set down hard on the grip, for to lose the hold meant delay and pushing by another car, and held on until Thirteenth Street was reached. Once the car started, everyone on the street, afoot or in carriages, must look out for the Juggernaut.

It was before the day of traffic regulation; the car gong was the only warning; there was no stopping once the grip took hold. As the car swung about the curves

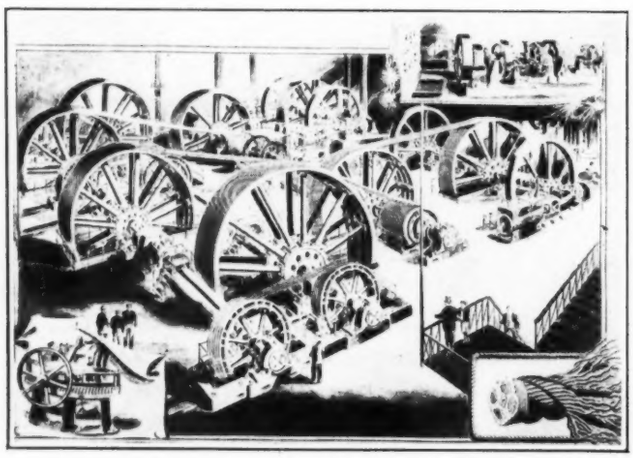


Fig. 1—The engine room of New York's first cable railroad

with grind of wheel flanges on rail, the motorman was stamping out the loudest sounds he was capable of producing on his gong. Everybody in that vicinity knew when a cable car was taking the turns on Union Square, each instantly becoming an interested spectator, for death often followed in the wake of those plunging, roaring, shrieking demons.

The scene at Union Square was duplicated on a smaller scale every time that car took the curve at any corner.

The lines were first laid out with an eye to a minimum of curves. After the Broadway line was operating from Thirty-sixth Street to the Battery, other cable lines were started and operated on Seventh, Lenox, Lexington and Third Avenues. The excitement connected with rapid transit spread over the city with every corner, every steep incline becoming the scenes of unrelenting death to those unfortunate enough to be in front of the cars.

There were also scenes of excitement and danger on straight stretches of roadbed when the cable "stranded." If the defect escaped notice of the cable watcher at the power-house cable well, the strands would pile up and choke the car grip so it could not let go. Then there was real excitement as the car kept on its way unchecked, full speed ahead, picking up other cars, trucks, anything in front of it, for the cable was driven by a 500-hp. engine. Sometimes drays, jammed helplessly between cars, would be piled in a line, moving down the street with every car gong clanging out its warning, until some conductor could jump off and reach a station and telephone the power house to stop the engine.

First Cable Railroad Started in the Nineties on Broadway

The first cable railroad in New York City was started in the early 1890's, to operate on Broadway. Possibly the inception came within a decade of when the Edison Company started its first station on Pearl Street with what the daily papers announced as "six mammoth steam dynamos of 120 horsepower each." The heart of the system lay in the cable station.

The first cable power house, as well as the office of the Metropolitan Street Railway, were situated at the corner of Houston Street and Broadway, where the cable building still stands. This power house held four Dixon Corliss single-cylinder engines of 1,200 hp. each, using steam at 130 lb. gage.

These engines were paired off, two to one grooved flywheel driving pulley on a jackshaft the same diameter as the engine flywheel. A smaller pulley on the first jackshaft drove ropes over a larger wheel on a second jackshaft. This last wheel was 34 ft. diameter with a 12-ft. face accommodating 25 rope cables. All the engine-room driving cables were cotton with a wire core and were manufactured in England. The largest driving wheels, of which there were two in the room, each operated another jackshaft, at the end of which was a pulley driving car cables of steel, 1½ in. in diameter. These latter passed four times around two pulleys in the engine room after entering and before going from the engine room to the street. One cable operated from the station to the Battery and return, the other on the opposite side of the room to Thirty-sixth Street. Jackshafts were in pairs, each pair connected with clutches, so either group

could drive on the system, singly or together. This engine room, Fig. 1, became a show place where large numbers of the public came to gaze upon the engines and watch the wheels go round—a fascinating, instructive scene at all times. Visiting engineers came from far and near to see the greatest engine room of the time.

The boiler room was no less imposing with its row of twelve Heine 2,500-sq.ft. water-tube boilers in majestic grandeur, enhanced by hustling firemen handling one ton of coal per hour each.

In Fig 2 are shown two boilers still in the old boiler room. These are reduced from their former proud estate of supplying steam at 130 lb. pressure to that of providing low-pressure steam during winter months for heating.

The power house was started under the guidance of a chief engineer, a son of the former chief engineer of

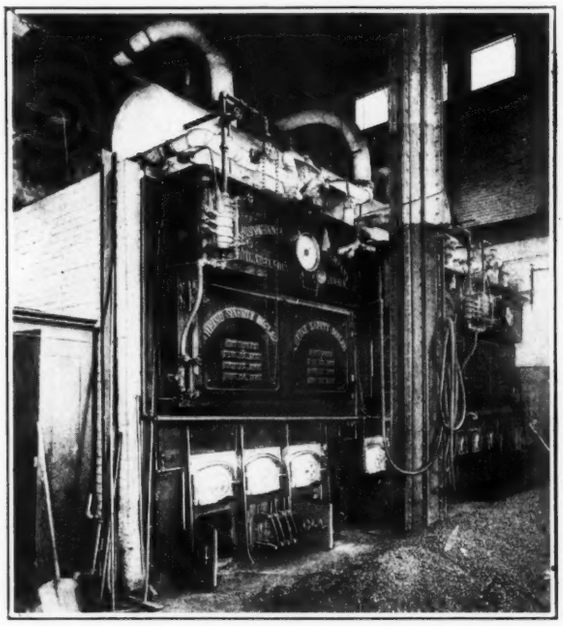


Fig. 2—Two of the boilers in the cable power house

the first Brooklyn Bridge organization. He was succeeded by John Lambden, who had as first assistant, J. C. Nesbit. Mr. Nesbit became chief engineer after Mr. Lambden transferred to the then new Ninety-sixth Street power house of the same company. William MacDonald, a former assistant engineer, still has charge of the engine room building as engineer-superintendent.

Operating the old station under the admiring gaze of the public was attended with excitement at times.

An oiler stepped down from the pillow block outside the two car-cable sheaves at one side of the engine room with the thought of all running smooth, no trouble today, his relief had come in, he would soon be washing up. As he left the last step, with foot in midair, he felt a quick tug of something over his shoulder. This something scratched a cut across his neck and as he stepped on the floor he heard a short loud blow struck on the floor 25 ft. from the far sheave, followed by seven other thumps, first on one side of the near sheave, then on the other, all over in less than a second. He knew the cable was stranded. A 25-ft. strand had come in with the cable at the rate of 22 ft. per second and had lashed about the room eight times to declare its presence. Long experience told the oiler what was wrong, and he lost no time in sounding the gong to signal the engines to a stop. The cable gang was put on the trail of the vagrant strand. The oiler examined himself and found a deep, livid scar on his neck where the tail end of the steel strand had scored. Had it wound about his neck, he would have been decapitated by that one strand.

As the cable lines were extended in the city, new stations were built at Twelfth Street and Seventh Avenue, at Fiftieth and Seventh Avenue, and at other points. In each there was the same operating history as at Houston, with some variations. The record of Houston Street was one of perfect operation with no shutdowns due to fault there. It is a good record. Inside of a decade the first station and the others were shut down owing to the rapid progress of transportation, the once wonderful, picturesque system gave place to what was called "the underground trolley." Those were "the days" the present generation knows nothing of.

WHAT DO YOU KNOW?

By L. H. Morrison

The answers are on page 1156

Ques. 1—Has pulverized coal ever been used in an internal-combustion engine?

Ques. 2—Why are high mean effective pressures not used in crankcase scavenging two-stroke-cycle Diesels?

Ques. 3—Would you use a heavier flywheel on a tandem-compound or on a cross-compound steam engine?

Ques. 4—Give four methods of cleaning the external tube surfaces of water-tube boilers.

Ques. 5—What makes discolored ice in a raw-water ice system?

Ques. 6—Will a bourdon gage work if the tube is of a round cross-section in place of an oval?

Ques. 7—Is a hoist using air from a compressor driven by a gasoline engine more efficient than one obtaining power direct from the engine?

Ques. 8—Has buckwheat anthracite coal as much heating value per pound as has the stove size?

Ques. 9—What is a trickle charge and at what rate should it be applied to a storage battery?

Ques. 10—What is a dynamotor?

Keeping 29 Elevators on the Job

Would it interest you to know how in one large building practically 100 per cent service is obtained from 29 elevators, and the cost of this service? Next week's issue will tell the story of operation and maintenance.

Fig. 1—Welding a generator at the General Electric works

Fig. 2—A 40-mile gas line welded by electric arc

Welding in Many Places

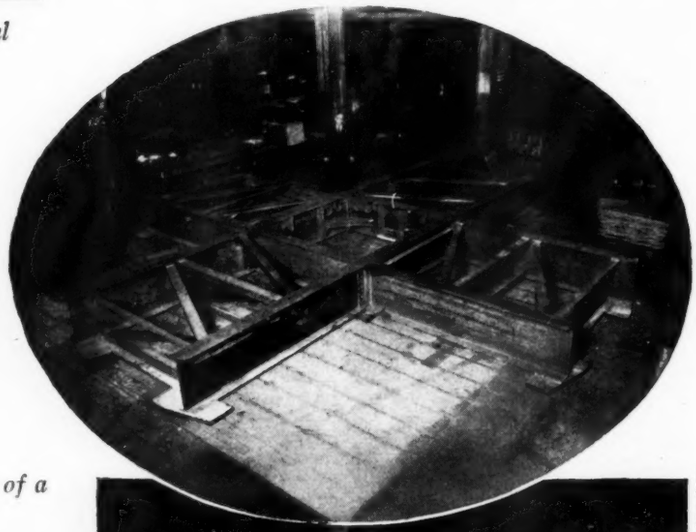


Fig. 3 (Right)—Welding the bearing bracket of a 40,000-kva. Westinghouse generator for Conowingo

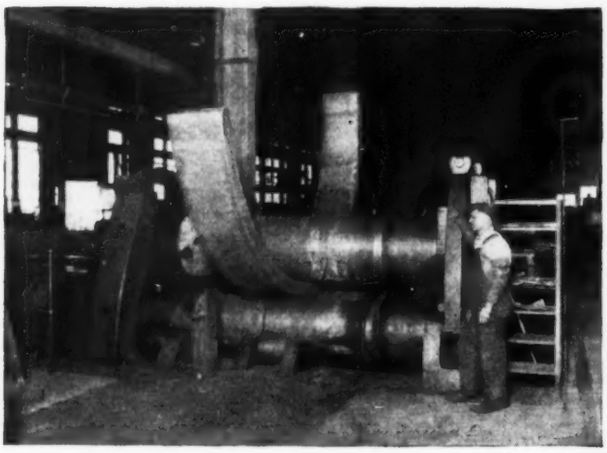


Fig. 4 (Above)—Rolling a bar to be welded to make a rotor rim

Fig. 5 (Right)—Welding the frame of a General Electric generator

PULVERIZED LIGNITE EXPERIMENTS

At the University of North Dakota

By R. L. Sutherland, N. T. Bourke and E. J. O'Keefe*

The University of North Dakota, as one phase of its work in assisting the promotion of the use of the fuel resources of the state, has been conducting experiments with pulverized lignite for steam generation. Results of some of the earlier work carried on by the late G. B. Wharen, professor of mechanical engineering, were published in the Quarterly Journal of the University in June, 1924, and in *Mechanical Engineering,* in June, 1926. Later experiments have been carried on with a unit of commercial size installed in the University power plant. The results obtained, while not definitely conclusive, seem of sufficient interest to warrant publication at this time.

THERE was available for the lignite burning experiments carried on at the University of North Dakota a No. 2B Unipulvo pulverizer direct connected to a 30-hp. induction motor. The normal capacity of the machine was given by the makers, the Strong Scott Manufacturing Company, of Minneapolis, as 2,000 lb. of bituminous coal of normal moisture content per hour.

The boiler used was a Babcock & Wilcox type F-14 Stirling with 2,400 sq.ft. of heating surface, set 6 ft. 11.5 in. above the floor. The furnace was designed for burning pulverized lignite, having an effective furnace volume of 1,140 cu.ft. and a burner of the fishtail type. Auxiliary equipment included Copes feed-water regulator, Diamond soot blowers and a Bailey flow meter indicating the furnace draft and recording the total steam, the steam flow, the air flow and the flue-gas temperature. An assembly drawing of the installation is shown in Fig. 1.

For comparative tests there was available a Babcock & Wilcox type F-15 Stirling boiler with 2,500 sq.ft. of heating surface set 2 ft. $2\frac{5}{16}$ in. above the floor with a semi-Dutch oven type of furnace, as shown in Fig. 2. The furnace had an effective volume of 650 cu.ft. and was equipped with a Universal sprinkling type stoker and pyramid non-sifting and dumping grates of 60 sq.ft. area, Copes feed-water regulator, Diamond soot blowers and Bailey flow meter similar to the one on the pulverized fuel boiler.

Lignite is a high moisture, low B.t.u. fuel, hence immediate success in its use without preliminary drying was not anticipated. Inasmuch, however, as the drier intended for use in connection with the pulverizer was not ready for operation, it was decided to experiment with the raw coal with a view to determining whether it could be successfully pulverized and burned without pre-drying and, if so, the efficiency and economy of such a process.

The first attempts to operate the pulverizer on lignite with all its original moisture content, were unsuccessful. The wet material packed in the mill and the power consumption increased beyond the capacity of the motor.

Following the successful application of preheated air in pulverizing wet coals in unit pulverizers, a modification in the set-up was made whereby gas taken from the furnace near the first bank of tubes, about 13 ft. above the bottom of the furnace and 3.5 ft. below the level of the top of the first baffle, could be drawn through the pulverizing chamber along with the air supply.

The air was drawn from above the boiler, over the furnace arch and through a pipe surrounding the hot gas pipe for as much of its length as structural conditions permitted. The temperature of the air above the boiler was from 40 deg. to 50 deg. F. higher than at the pulverizer level. In addition, the air, in passing through the pipe surrounding the hot gas pipe, absorbed the heat radiated from it and entered the pulverizer at approximately 225 to 250 deg. F.

A series of samples of the pulverized lignite was taken from the fan outlet for screen analyses and determination of moisture content. From the results a curve was plotted showing the average relation between the dry bulb temperature of the carrying air and the moisture content of the dust. The temperature of the dust after removal from the air stream was found to be from two to five degrees Fahrenheit below the dry bulb temperature of the air. The results are shown in Fig. 3.

In addition to the samples of dust from lignite of high original moisture content, four samples of dust from lignite partly dried before pulverizing are included. From these a second curve was drawn, which, together with the curve for the raw lignite, indicates a lesser reduction in moisture content in proportion to outlet temperature as drying becomes more complete.

The variation from the average, of the points from which the curve is drawn, may be due to one or more of several causes, among which may be mentioned: The moisture content of the lignite as fed; the temperature of the lignite, which varied from below the freezing point to 60 deg. F.; the size of the material as fed and the relative proportions of air and dust.

*College of Engineering of the University of North Dakota.

The results indicate that the moisture content of the dust produced for any given outlet temperature, decreases with decrease in the size of lignite as fed. The moisture content of the dust from mine waste under $\frac{3}{4}$-in. is below, under $\frac{1}{4}$-in. is close to, and the 2-in. is above the average.

The selection of a pulverizer for the large-scale experiments was based upon the experiences of the preliminary experiments. Owing to the drawing of a relatively high proportion of the total air required for combustion through the mill, it was found necessary to remove the fines from the pulverizing chamber. Since this resulted in the removal of coarse particles along with the dust, a gravity separator or classifier was required to separate the oversize and return it to the mill for further grinding.

The Unipulvo pulverizer is designed to permit the passage of all the air for combustion through the pulverizing chamber; oversize material is removed in a cyclone separator mounted above the pulverizing chamber and returned for further grinding.

In the earlier part of the work, when the lignite was fed in a frozen condition and the available supply of furnace gas was limited, the original fan was found inadequate to remove the dust from the pulverizing chamber. When a larger fan was installed and the volume of air passing through the mill was increased sufficiently to remove the dust, oversize particles were drawn out with the dust. A portion of this oversize entered the furnace and fell to the bottom incompletely burned.

After various changes in the separating chamber had been made in an attempt to correct the difficulty, the volume was increased by adding ten inches to its height. With this additional volume the velocity of the air and dust stream was reduced sufficiently to effect a fair separation.

At higher boiler ratings, above 125 per cent, the separation was satisfactory and the power consumption per ton of lignite pulverized was a minimum. At lower ratings, with decreased air velocity through the machine, the dust was not removed from the pulverizing chamber efficiently, resulting in an increase in the power required per ton of lignite pulverized.

Samples of the dust were taken between the pulverizer and boiler by means of a small cyclone separator. The samples were taken through a one-inch pipe inserted in the dust stream. Circulation through the pipe and separator was created by connecting the outlet of the separator to the fan inlet, the rate being controlled by a damper in the connecting pipe. No dust filter was used to remove the finest dust; it is probable therefore that a part of the fine dust was not recovered.

The average results of the screen analyses of samples of dust taken during the preliminary and later test periods are given in Table I and Fig. 4.

Experience in the operation of the installation indicated that when 78 per cent or more of the dust was finer than 50-mesh, there was no appreciable loss through combustible dropping to the bottom of the furnace.

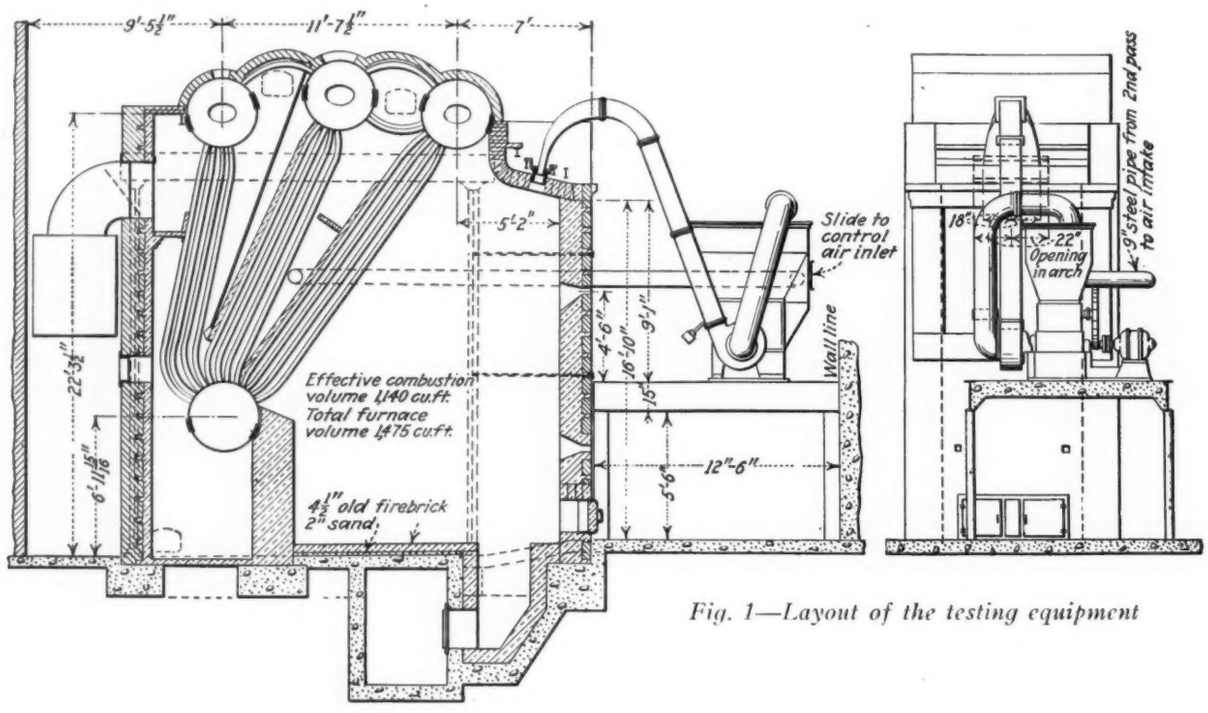


Fig. 1—Layout of the testing equipment

The Unipulvo pulverizer, as the name implies, is of the unit type. The fan is large enough to draw all the air required for the combustion of the fuel through the pulverizing chamber.

Since the drying was effected in the pulverizer, the figures on power consumption cover all power used in drying, preparing the fuel, feeding it into the furnace and furnishing all the air for combustion.

TABLE I—TEST OF FINENESS

Mesh	Preliminary Test Period, Per Cent Passing	Later Test Period, Per Cent Passing
20	93.1	99.7
30	82.8	97.5
50	67.2	90.4
60	59.7	84.1
70	53.8	80.5
80	47.3	78.5
100	38.9	69.8
200	17.6	34.4

Tests of the installation indicated the power consumption per ton of lignite pulverized depended on a number

of factors, among which may be mentioned: The temperature, moisture content and size of the lignite entering the machine; the volume and initial temperature of the air used for removing the dust from the pulverizing chamber; the weight of lignite pulverized per hour and the fineness of pulverizing and the percentage of the total moisture of the lignite removed in passing through the machine.

With so many variables involved it is not possible to determine accurately the effect of each on power consumption. An indication of the effect of initial and final moisture content, size of lignite fed and the fineness of grinding, on power consumption, is given in Table II.

TABLE II—POWER CONSUMPTION FOR PULVERIZING

Date	Size of Feed, In.	Boiler Rating, Per Cent	Moisture in Fuel Entering	Moisture in Fuel Exit	Per Cent of Dust Finer Than 100-Mesh	Kw.-Hr. per Ton of Lignite as Fed
			Lignite			
April 8.....	2.0	150	.....	24.64	....	24.45
15.....	2.0	152	36.19	.....	55.0	25.41
16.....	0.75	162	35.97	21.73	68.8	21.57
June 6.....	0.75	143	32.23	16.0	59.9	20.48
7.....	1.25	155	31.58	19.33	41.7	19.83
			Pocahontas Screenings			
April 9.....	1.0	162	2.88	0.48	93.7	20.4

The results indicate that in general the power consumption decreases with decrease in the initial and final moisture content of the lignite and increases with finer grinding.

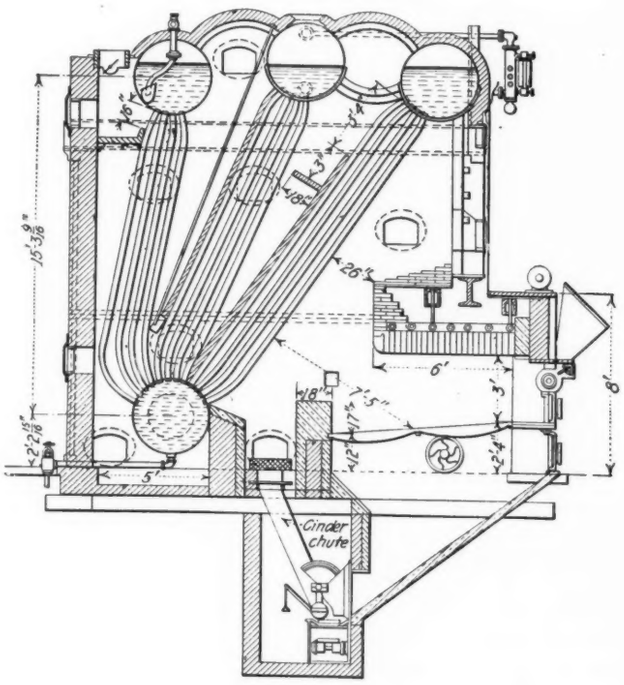


Fig. 2—The second boiler used in the tests

Power readings were taken to determine approximately the proportions of the total power used in the various operations. Two series of readings were taken: No. 1, the power to operate the motor, pulverizer shaft with hammers removed and the fan; No. 2, the power to operate the motor, pulverizer shaft with hammers in place and the fan. The weight of air was determined from readings of a Pitot tube in the fan outlet pipe. A correction factor, determined by experiment, was applied to the Pitot tube readings in computing the weight of air moved.

Results of the tests are plotted in Fig. 5.

From the curve the minimum power for turning the rotor shaft and fan with damper closed and for motor loss, was 4.5 kw. The additional power to overcome the inertia and the fan effect of the hammers was from 4.5 to 3.5 kw. With the type of Pitot tube available it was not possible to measure the air flow when the machine was under load.

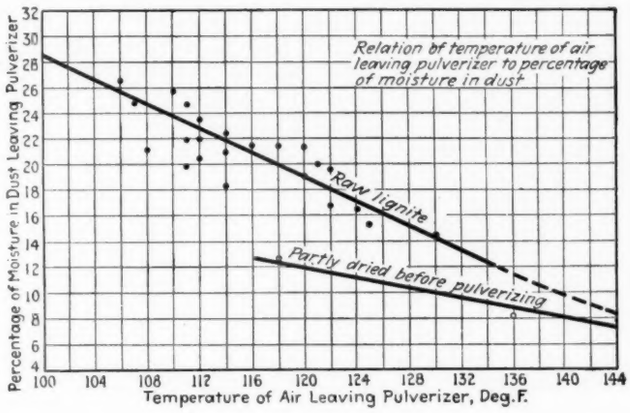

Relation of temperature of air leaving pulverizer to percentage of moisture in dust
Raw lignite
Partly dried before pulverizing
Percentage of Moisture in Dust Leaving Pulverizer
Temperature of Air Leaving Pulverizer, Deg.F.

Fig. 3—Relation of air temperature to moisture content

In a series of boiler tests for which power data are available, the average boiler rating was 153 per cent and the average capacity 2,839 lb. of raw lignite per hour, for which 5.52 lb. of air per lb. of lignite was supplied, or a total of 15,670 lb. of air per hour. The average power was 30.97 killowatts.

From Fig. 5 the net power for pulverizing was 30.97 — 11.10 = 19.87 kw. The net power for moving the air was 11.10 — 4.5 = 6.6 kw. Dividing the 4.5 kw. friction and motor loss proportionately between the two, the total power for pulverizing was 23.25 kw. and for moving the air 7.72 kw. The power consumption per ton of lignite fed was: For pulverizing, 16.36 kw.-hr. and for moving the air 5.44 kw.-hr., a total of 21.8 kw.-hr.; 75 per cent of the power was used in pulverizing and 25 per cent in moving the air.

The average power consumption per ton of lignite pulverized was 21.8 kw.-hr.; the power consumption per ton of Pocahontas screenings was 20.4 kw.-hr. A comparison based on heat value of the fuel pulverized shows a total liberation of 618,900 B.t.u. per kw.-hr. for the lignite and 1,389,200 B.t.u. per kw.-hr. for the Pocahontas coal.

To test the reliability of the equipment, the pulverizer was operated without interruption for ten days, and then it was shut down to allow the installation of an improved furnace gas connection. In this run no attempt was made to maintain maximum capacity, the aim being to carry a rating at which the pulverizer could be operated without excessive attention. An average boiler rating of 112 per cent was carried during the test. The average analysis of the sample of stack gas taken was: CO_2, 12 per cent; O_2, 8 per cent; N_2, 80 per cent.

The average moisture content of the dust samples taken was 25.7 per cent, with an average temperature of the air leaving the machine of 106.5 deg. F.

Other continuous runs of the pulverizer were 7, 10, 15 and 10 days. No run was discontinued on account of difficulties in either pulverizer or furnace.

Boiler tests were conducted as nearly as possible in accordance with the 1923 Power Test Code of the American Society of Mechanical Engineers. The fuel was weighed on tested platform scales and elevated to the overhead bunker. The feed water was weighed and fed to the boiler through a line protected from loss or additions by double valves with a bleeder between.

Uniform operating conditions were not obtained in the first test. The lignite fed to the pulverizer was frozen, and not enough furnace gas could be drawn into the pulverizer to effect the necessary drying at the desired capacity. The average temperature of the air leaving the pulverizer was 87.5 deg. F. Later experience indicated that uniform conditions at or above normal boiler rating were obtained only when the outlet temperature was above 100 deg. F.

The furnace was operated at temperatures that would not cause serious slagging of the ash. Temperatures were not measured; however, the relative temperatures are reflected in the CO_2 content of the stack gas, which ranged from 4.5 to 8 per cent. Higher CO_2 and higher furnace temperatures could be maintained when the ash content was low and the fusion temperature of the ash high.

The larger ash particles, mostly clay and other impurities, settled at the front of the furnace directly below the burner. This part of the ash was removed daily through the bottom discharge gate. The lighter ash that settled at the back of the furnace was allowed to accumulate and was removed when the setting was cooled after a test period. The greater part of the ash was carried out with the stack gas. When the lignite was free from clay and the ash content low, very little ash settled to the bottom of the furnace.

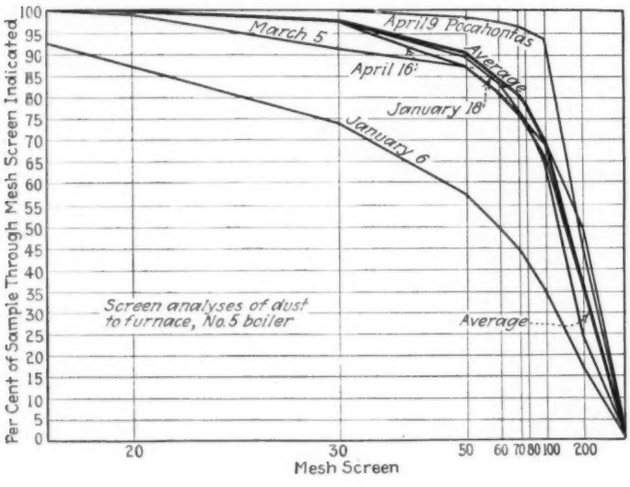


Fig. 4—Fineness of the coal dust

On account of the impossibility of removing all the refuse accumulated during a boiler test, no attempt was made to determine the amount of combustible in the refuse. When removed, it was practically free from unburned material. Only a small amount of refuse settled in the back of the boiler setting, apparently chiefly granular material blown off the tubes by the soot blower; 1.7 per cent of combustible was found in this portion. No samples of dust were collected from the stack gas.

Complete combustion could be obtained in the pulverizer furnace with slight excess of air; however, the relatively low fusion temperature of the ash required the admission of sufficient excess air to prevent slagging.

With lignite of low ash content, good fuel and air distribution could be maintained on the grates of the stoker-fired boiler. When the ash content was high and its fusion temperature low, as in boiler test No. 9, less satisfactory air distribution could be maintained and the efficiency was low. This material was very difficult to burn on the grate and would not be suitable or economical for regular use.

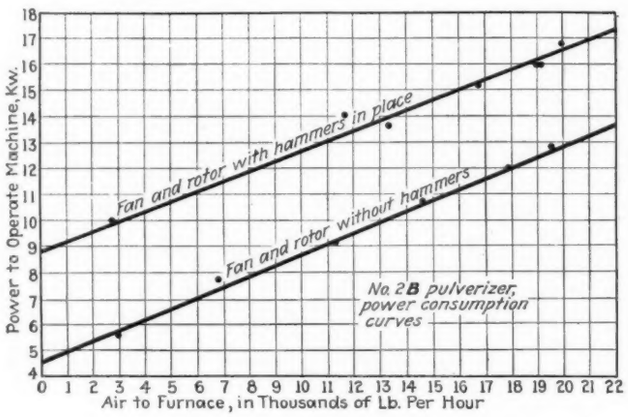

Power to Operate Machine, Kw.
Air to Furnace, in Thousands of Lb. Per Hour
Fan and rotor with hammers in place
Fan and rotor without hammers
No. 2B pulverizer, power consumption curves

Fig. 5—Power consumption of pulverizer

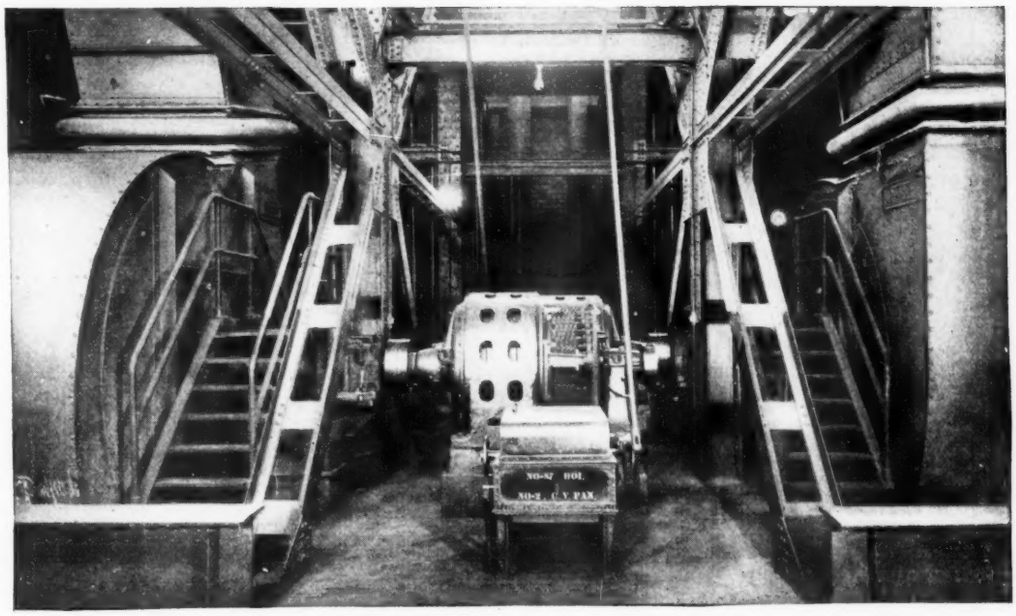
A slightly better grade of slack from the same mine was burned in the pulverized form without difficulty and with an efficiency about 2 per cent less than that obtained with the better lignite from the same mine.

The average rate of fuel consumption maintained in the boiler tests was 2.44 lb. of lignite as fired, equal to 16,540 B.t.u. per cu.ft. of effective furnace volume. In the test of Pocahontas coal 19,100 B.t.u. per cu.ft. per hour was liberated.

The heat liberated per cubic foot of effective furnace volume compares favorably with the results in commercial practice for bituminous coal with furnaces and burners designed for long flame travel. At the Lake Shore plant of the Cleveland Electric Illuminating Company the heat liberation ranges from 8,000 B.t.u. per cu.ft. at normal ratings to a maximum of 15,000 B.t.u.; at the Trenton Channel plant of the Detroit Edison Company the heat liberation ranges from 10,740 B.t.u. at normal ratings to a maximum of 19,000 B.t.u.

The "unaccounted for loss" was practically the same in the two types of furnace and is high in both cases. The 16 per cent "unaccounted for loss" in the test of Pocahontas screenings was higher than in the tests of lignite. The causes of the excessive losses are being investigated, using more refined methods of stack-gas analysis.

Experiments in the pulverizing of lignite, with and without separate drying in the waste-heat drier, are being continued. Changes in the furnace, designed to increase the rapidity of ignition and the length of dust and gas travel within the furnace, are to be made. The relative over-all fuel economy of the two methods of drying, pulverizing and burning lignite will be studied.



Adjustable varying-speed commutator-type 150-hp. polyphase motors driving induced-draft fans

Factors That Influence the

Selection of Motors

for Power-House Auxiliaries

By H. L. Smith

Industrial Engineering Department, General Electric Company

THERE are a few fundamental principles that should govern the choice of drive for those power-plant auxiliaries the continuous operation of which is essential for the proper operation of the plant. These may be classified as reliability and simplicity.

Reliability is the most important requirement. Any type of motor and control used should be so arranged that a momentary interruption in voltage will not shut down the auxiliaries. In case of a prolonged interruption of voltage, the auxiliaries should go back into operation with the resumption of voltage either automatically or with as little attention on the part of the operator as is consistent with simplicity.

The simplest types of motors and control and their arrangement should be used, consistent with the economy of operation and the particular characteristics of the auxiliary itself. The types of equipment will first be discussed and, later, their application to the particular auxiliary.

As practically all large power stations generate alternating current, it is desirable to use alternating-current rather than direct-current motors, though for one or two applications, such as stokers and coal feeder drives where a wide speed range is required, direct-current motors are often preferable.

The alternating-current motor has the advantage that it is simple and of sturdy construction, and is low in first cost and maintenance. For constant-speed service the squirrel-cage induction motor is the simplest and usually the best adapted and may be used on most of the auxiliaries.

Squirrel-Cage Induction Motors

The practice of starting squirrel-cage induction motors on full voltage (except in special cases where the torque must be applied gradually) is being more and more generally adopted. This simplifies the control, requiring only a line switch with suitable overload or short-circuit protection.

Starting squirrel-cage induction motors on full voltage increases the stresses on the end connections of the stator winding during the starting period owing to the high current inrush, and this must be considered in the design of the motor. In the high-speed motors of large capacity, either blocking of the coils or bracing the end connections to a binding ring is necessary.

The high-reactance, squirrel-cage induction motor, often referred to as the double-squirrel-cage motor, has been used to a large extent for full-voltage starting, as it takes a lower starting kva. from the line than the corresponding single-squirrel-cage induction motor.

As the auxiliary power available is generally sufficient to start the standard type of squirrel-cage induction motor of the smaller sizes on full voltage without disturbance, there is no advantage in using the special high-reactance motor. In the larger sizes, however—100 hp. and above, especially high-speed ratings—there is a decided advantage in using this type of motor because of its lower starting current.

High-reactance squirrel-cage induction motors started on full voltage take from 4½ to 6½ times full-load current, while the standard squirrel-cage induction motors require from five to ten times full-load current. The greater the number of poles and therefore the lower the speed of the motor, the less is the difference between the starting current taken by the high-reactance and the standard-type squirrel-cage motors.

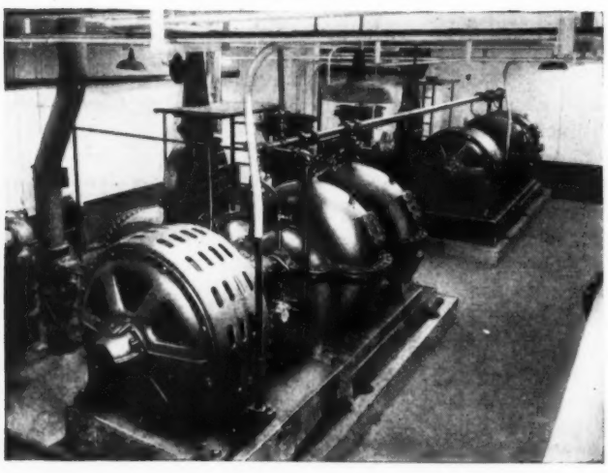
High-reactance motors can be built to take starting currents lower than those previously mentioned, but this can be done only by sacrificing the maximum torque and other characteristics desirable for motors in this class of service. The distinct advantage of starting motors on full voltage is that very simple control may be used.

Wound-Rotor Induction Motors

Wound-rotor induction motors are used extensively where a speed reduction is required or where starting current must be limited below that obtainable with squirrel-cage induction motors. When used on the essential auxiliaries, automatic restarting with arrangement for the unit to come back to its original speed is often employed. This can be readily accomplished by means of a master switch and contactors in the secondary circuit and does not affect the design of the motor. Where automatic restarting is used with drum controllers arranged for a pre-set speed, it is necessary to add a separate starting resistance having 10 or 15 per cent of the normal resistance, in conjunction with a short-circuiting contactor and time relay. This is required to insure restarting of the motor even if the drum controller should be in the high-speed position, and it also limits the starting current in this position. When such an arrangement is used, it is often necessary to block or brace the end turns of the stator winding.

There are two motors of the commutator type—one

Fig. 1—Induction motors rated at 250 hp. driving circulating water pumps



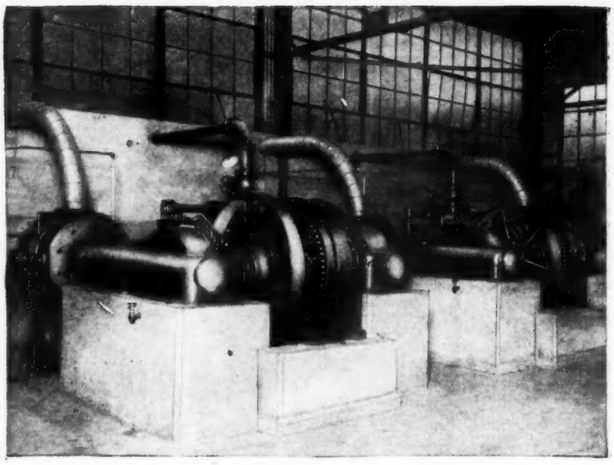


Fig. 2—Synchronous motors driving air compressors

having a series characteristic and the other a shunt characteristic. The motor having a series characteristic has been used extensively for driving induced- and forced-draft fans, where a speed range of 2 to 1 or 3 to 1 is required. A wound-rotor induction motor can be used for a speed range of 2 to 1, but it is not recommended for speed ranges of 3 to 1 because of the instability of the motor at these low speeds and the low torque obtained at these speeds on a fan drive. The alternating-current commutator motor is stable over the whole speed range and, in addition, has a considerably better efficiency and power factor than the corresponding wound-rotor induction motor at these reduced speeds. The control is also simpler and requires less space than for the wound-rotor motor. Another advantage is that the speed change on the commutator motor is smooth, there being an infinite number of speeds secured by moving the brushes around the commutator.

Alternating-Current Commutator Type Motors

The alternating-current commutator motor having shunt characteristics finds its best application for stoker or fuel feeder drive where a speed range of 3 to 1 or 4 to 1 is required. The great advantage of this motor is that the speed for any brush setting changes very little with variations in load; that is, the speed torque characteristic is similar to that of the shunt-wound direct-current motor, and this is a desirable characteristic. The motor also has a very high breakdown torque at any speed setting, which is also a desirable characteristic for a stoker motor.

The shunt type of alternating-current commutator motor can be used for any of the conditions where the series type is applicable. It is limited, however, to a lower horsepower rating per pole than the series type, so that on the larger sizes it cannot be built for as high a speed as the series-type motor. It is also limited to 550 volts or less, whereas the series type of motor can be built for any voltages which could be used on the corresponding induction motor.

It is sometimes asked why the alternating-current series characteristic commutator motor, widely used for driving draft fans, would not be open to the same objections, so far as the commutator is concerned, as the direct-current motor. While the latter has full voltage across its commutator between the brushes, the voltage between the brushes on the series characteristic alternating-current

commutator motor is very low. This voltage varies with the speed at which the unit is operating, but is generally less than 2½ volts per commutator bar, maximum. Further, on the alternating-current commutator motor driving a fan load, the voltage between commutator bars is lowest when the motor is operating at the higher speeds, and therefore, at the maximum load. For this reason there is practically no tendency toward commutator or insulation troubles caused by the collection of coal or coke dust, which is always present where induced- or forced-draft fans are located. In the headpiece is shown a 150-hp. series characteristic alternating-current commutator-type motor driving an induced-draft fan.

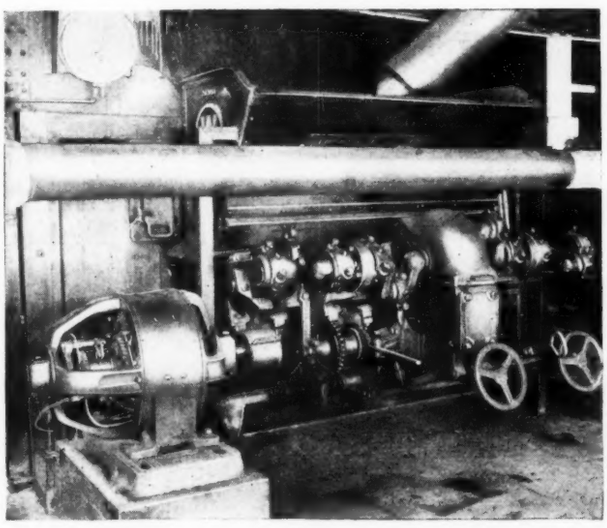
Synchronous Motors

For the essential auxiliaries it is often the practice to select a motor having a much higher horsepower rating than that required by the pump for normal conditions. This means that the motor is operated at part load, the power factor is low and for this reason consideration now is being generally given to synchronous motors. The synchronous motor is, of course, limited to those units where speed regulation is not required, and this includes the condensate and vacuum pumps, air compressors and, in some cases, circulating pumps.

Synchronous motors can be designed to start centrifugal pumps or fans satisfactorily under load. In addition to giving a high power factor for the system, they have a higher efficiency, over the corresponding induction motor, especially if operated at unity power factor. There is the added complication of direct-current excitation, which requires either an exciter or a motor-generator set. The greatest disadvantage of the synchronous motor is that, on a dip or momentary loss of voltage sufficient to cause the motor to fall out of step, the field must generally be disconnected before the motor can be resynchronized.

Upon loss of line voltage the synchronous motor will act as a synchronous generator, delivering voltage to its line. This voltage will depend upon the excitation of the motor and upon other loads connected to the same line as

Fig. 3—Direct-current motor rated at 3 hp., 300 to 1,200 r.p.m. driving an underfeed stoker



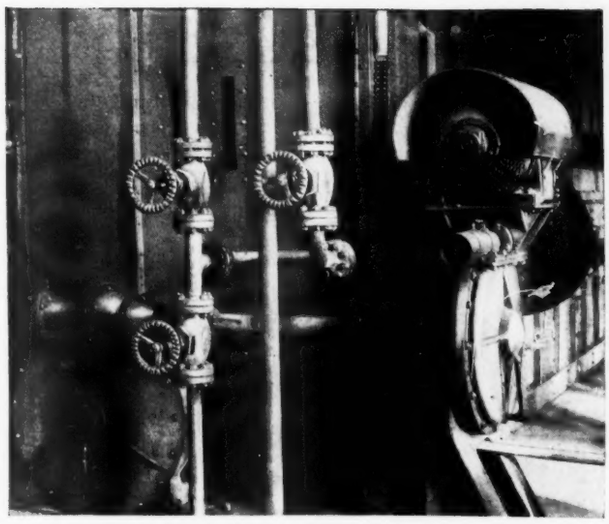


Fig. 4—Direct-current motor rated at 1.7 to 2.6 hp., 500 to 2,000 r.p.m., driving a traveling-grate stoker

the synchronous motor, into which the motor would pump back power. The rate at which this generated voltage would fall will depend upon the inertia of the motor and upon the character of the driven load. While an instantaneous undervoltage relay can be used in certain cases to remove field excitation and to allow the motor to resynchronize, in other cases, such as where the auxiliaries are transferred from one bus to another, the instantaneous undervoltage relay would not be sufficient, and it is necessary to use a reverse-power and no-power relay or some other means to open the field circuit.

When a synchronous motor is used on a duplex set, the turbine would drive the synchronous motor as a synchronous generator at a speed only a little below synchronous speed on loss of alternating-current supply, and automatic control in this case becomes quite complicated.

Because of these complications in the control, it is questionable whether in the medium and small sizes the increased efficiency and power factor secured with a synchronous motor justifies its use on an essential auxiliary. However, where motors of large capacity or low speed are concerned, the general characteristics of the synchronous motors become desirable. In such cases the starting characteristics of the motor and the type of control—especially with reference to keeping the motor running during line disturbances—should be given special study. There are some of the non-essential auxiliaries, especially the slow-speed units such as air compressors and vacuum pumps, for which the synchronous motor makes the most desirable form of drive.

Direct-Current Motors

A great many industrial plants generate direct current, so that in these plants direct-current motors are used on all of the electrically driven auxiliaries. The general tendency, except in a few stations, has been to keep away from direct-current motors on the essential auxiliaries.

There are certain auxiliaries on which the direct-current motor makes the best type of drive, and even in stations in which alternating-current is used on all the essential auxiliaries, direct-current motors are used on the stokers or fuel feeders, owing to the wide speed range which can be easily secured by field control.

The requirements of control for this service are dif-

ferent from those in industrial applications; reliability and simplicity are the most important features, but the following points must be considered:

For the essential auxiliaries the overload relay should not trip the oil circuit breaker or switch on short time overloads, but should be set to protect against short circuits in the motor winding, leads or cables between the oil circuit breaker and the motor. There can be no overload on this class of station auxiliary if the motor capacity is properly chosen unless some mechanical failure occurs. The overload relay should, therefore, be preferably instantaneous in operation or should function in as short a time as possible.

Undervoltage protection should be omitted on the essential auxiliaries so as to permit automatic restarting after voltage interruption.

Where overload protection is desired on the motor, especially where full-voltage starting is used, a temperature relay that has thermal characteristics similar to the heating characteristics of the motor, is preferable. Rather than have this relay shut down the motor directly in case of overload, it should be connected to a relay circuit so as to operate an alarm in case of overheating of the motor.

On the miscellaneous auxiliaries it is desirable to protect the motors against overload and both overload and undervoltage protection are generally used. As many of these motors are of the squirrel-cage induction type started on full voltage, the thermal-type overload relay seems to be the best device for the purpose, as it will not trip out on a high inrush current at starting and can still be set low enough to give the proper overload protection.

Control equipment used in this service may operate continuously for long periods of time without any shutdown. When contactors are used having copper contact tips, oxidation is likely to occur, causing overheating, and the facing of contacts with material which prevents this oxidation is desirable.

Don't Neglect A.-C. Motor Compensators

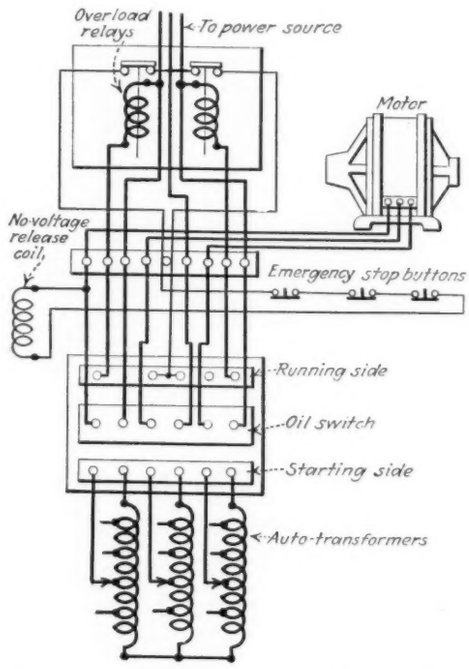
By Guy W. Kay

ALTHOUGH the installation and maintenance of starting compensators for alternating-current motors is comparatively simple, they are frequently not given proper attention. These starters are usually installed with overload relays and a no-voltage release built in as part of the equipment. When installing, care should be taken to have the overload relays properly adjusted; if not, they are of no value for motor protection. The taps on the starting side of the transformers should be taken from the points that will give the lowest voltage at which the motor will start satisfactorily with its connected load.

In some installations it is necessary to install stop or safety switches at distant points from the compensators. This is easily done, as indicated in the figure, by connecting them in series with the no-voltage release coil. As many switches as are necessary are wired in series. These switches should be of the normally closed type. When one of the switches is opened, the no-voltage release coil circuit is interrupted and stops the motor.

On certain types of compensator the starting lever must be thrown quickly from the starting to the running position to get by the off position. On types where this safety feature is not provided, the change from the starting to the running position should never be made slowly, since an arc may occur at the contacts and the motor will slow down.

The contacts should be inspected at regular intervals, and if found burned, they should be filed to a good surface or replaced. If the contacts are neglected, there is danger of one phase being made open by a poor contact. If this happens to be on the running side, the motor can



Three-phase starting compensator with stop buttons connected in series with no-voltage release coil

start when connected to the starting side of the compensator. When connected to the running side, the motor will continue to run, but will be operating single-phase, and, if left running this way under nearly full load, the winding may be roasted out. This may also happen where starting and running fuses are used. If one of the running fuses blows, the motor can still be started polyphase through the starting fuse, but when connected through the running fuses, it will be operating single phase.

If the motor is operating under light load, it may run this way for a long time without the open phase on the running side of the starting device being discovered. Operating with one phase on the starting equipment causes the load on the line to be unbalanced. The most serious objection, however, to this way of operating is that the motor may have its load increased and may burn out before any one discovers the open phase.

The oil in the switchbox should be watched and maintained at the proper level. When it shows signs of discoloring and contains carbon particles, it should be changed. The dashpots on the overload relays should be kept clean and filled with the proper grade of oil. Loose connections are frequently the source of trouble. To insure against such faults, all connections should be carefully checked on each regular inspection.

Why the Plant Sells
DISCOLORED ICE

By A. G. Solomon

IN THE old days, when all ice was made from distilled water, the engineers often faced some puzzling problems to keep the ice clear and free from discoloration.

Oil and boiler compounds, as well as sediment contained in the water, had to be contended with. And the distilled water attacked the iron pipe and fittings and caused rust. Care had to be used in the selection of the proper lubricating oil for use in the steam cylinders of the engines and of the many steam-driven pumps that were needed in this type plant. Oil separators were installed in the exhaust lines to stop the oil from passing into the steam condensers.

After condensation the water had to be passed through filters containing quartz and charcoal. The filters had to be cleaned of the accumulation of oil by blowing with live steam. The water-cooled fore-cooler coils through which the distilled water passed were blown out with live steam to remove the oil that clung to the inner surfaces. If the cooling water failed to flow over these coils for a few minutes, the hot distilled water coming direct from the re-boiler would send a lot of oil to the water-storage tank.

Raw water mixing in with the distilled water would cause bad ice. Gases and air also played a part in putting murky ice on the delivery wagons.

These faults are only a few of the many causes of discolored ice in the distilled-water plant.

But the distilled-water ice plant, with its many difficulties, is a thing of the past. Now water direct from the city mains or from wells is put into the ice cans and a product that is absolutely clear and pure can be turned out.

There is often considerable trouble in keeping every block of ice as clear as is desired, and white ice is more common now than with the old distilled-water plant. I do not mean that the entire block is white, but the center of many blocks has a big core that is as white as cotton. If the air agitation system stops for a few minutes, the ice shows a white streak all around where the water was frozen.

In some plants the power is not as reliable as is necessary to produce good ice all the time. The current will be cut off for short periods, and this interruption causes bad-looking ice.

In such plants the installation of an oil or gas engine to drive the blower or air compressor will be found convenient in case of emergency. Being assured of steady agitation of the water in the ice cans is necessary.

This agitation is sometimes stopped in other ways than by the failing of the power.

The freezing of the moisture contained in the air is often the cause of considerable trouble. This freezing occurs oftener in the winter than in warm weather.

Dehydrators and other devices for the removal of moisture in the air are in use in many plants. But such refinements are found to be unnecessary in a great number of ice plants, and the grade of ice made compares favorably with that turned out of the plants equipped with all the latest improvements for the handling of the agitation.

The washing of the filters and the refilling of cores requires more water than most engineers realize.

> Where no competition exists the ice plant has no difficulty in selling its ice, no matter how discolored. But the advent of a competitor means that the ice must be made crystal clear or the newcomer gets the business. Inferior ice can be eliminated by proper operating procedure.

When we consider that the cost of water per ton of ice made amounts to from five to ten cents, we know that it pays to be watchful. Most plants can cut a few hundred dollars per year from the city water bill if care and good judgment be used.

Use what water is necessary, but be careful not to waste any.

For good service two filters are needed between the meter and the fore-cooler. Filters of the proper size and filled with gravel and sand will take out nearly all the sediment. A small amount of alum is needed with most water to form a filtering mat at the top of the filter. The use of too much alum causes white flakes to show in the ice.

The water enters the top of the first filter and passes downward, then goes to the top of the second filter. From the second filter the water goes through a float-controlled valve to the fore-cooler. This is all the filtering that is necessary with most water.

If further filtration is needed, the proper place for the filters is between the fore-cooler and the can fillers.

Some water contains sediment that will not filter out except at a low temperature. For this reason the water is filtered after cooling. It seldom happens that this filtration of the cold water fails to remove every trace of sediment that might discolor the ice.

The outlet from the fore-cooler to the filter should be at least six inches from the bottom of the fore-cooler to provide a settling chamber. The drain being located at the bottom of the fore-cooler, the sediment is drawn out.

The washing of filters and draining of fore-coolers should be done at regular intervals.

Changing the Filter

The charging of the filters with gravel and sand is not a difficult job, but it can be done wrong. First, a screen is placed so that it rests about four inches from the bottom of the filter. The holes in this screen should be at least one-quarter inch in diameter. Holes smaller than this can more easily become blocked, and this will prevent proper distribution of the water over the entire filtering surface.

On top of this screen is placed a four-inch layer of one-inch gravel. On top of this large gravel will be a layer of the next smaller size. This second layer should be four inches thick and the gravel should be between one-half and three-quarters of an inch in diameter.

These two bottom layers will be the foundation and will be a guard to prevent the smaller gravel getting into the holes of the screen.

Above this foundation will come the layers of graded gravel. The number and thickness of the layers will depend on the number of sizes of gravel used. As a rule there will be five or six layers six inches thick. The top layer of gravel will be nearly like coarse clean sand.

On top of the gravel will be the filtering sand. This is known as silica sand, and no other should be used. The proper sand will stop the sediment contained in the water and will give up this sediment readily when the filter is back-washed.

Fill the space above the gravel with this sand to within four inches of the water inlet. No screen is needed at the top of the filter.

Do not use any filtering material but such as is known to be made for this service.

After the filters are charged, the water should be allowed to flow through from top to bottom for at least three hours. This will settle the sand and gravel into place. Next give the filters a good back washing. Open the outlet valve wide, so that the water has a free passage to the sewer. Then open the valve that allows the water to enter the filter below the bottom screen. At first this valve should be opened just enough to allow a small stream to come out of the outlet. As this outlet stream becomes clear, open the inlet valve a little more. Some sand will be washed out, but not enough to do any harm.

After about ten minutes of slow washing, the inlet valve should be opened wide and water under at least 20-lb. pressure allowed to pass through the filter for ten minutes more. Even then some sand may be washed out, but the water will be clear.

Now see that the alum pot is filled and set to feed alum in with the water as soon as the water is turned through the filters and into the fore-cooler. Do not rush this first filling, but regulate the flow with the inlet valve to the filters. As the float-controlled valve in the fore-cooler is wide open, the sudden rush of water may cause sand to be carried over. After the water in the fore-cooler has reached a height so that the float begins to act, open the inlet-water valve wide.

Let the fore-cooler fill up to the overflow and then set the float so that the water will skim for half an hour. Then wait about an hour and open the drain and blow out any dirt that may have been in the fore-cooler or on the coils.

Now we are ready to put water into the ice cans. Keep close watch on everything during the process of filling the cans, watching the agitation, as well as the sucking and filling of the cores. Then look at the ice as it is dumped into the ice vault.

If the ice shows no discoloration, further filtering is unnecessary. But if any trace of sediment shows in the ice and its cause is not traceable to anything else, it means that some sediment did not filter out.

The water that enters the fore-cooler after passing through two filters will have a chance to deposit some of its remaining sediment in the bottom of the fore-cooler. Regular draining of the fore-cooler will remove most of this sediment.

In the fore-cooler the temperature of the water is lowered 15 to 25 deg. F. Some water will give up sediment to the filters at a temperature of 45 to 50 deg. F. that would pass through the filters at a temperature of 70 deg. or higher. The water passing from the fore-cooler to the can filler has a slow rate of travel and this allows for good filtration.

In some plants the water is so free from impurities that it goes direct to the fore-cooler from the city main. In such places it is usual practice to filter only such water as is used for filling cores. The filter is placed between the fore-cooler and the core filling hose.

Flushing Out the Dirt

Some water contains sediment that will cling to the inner surface of the pipe work and hose between the filter and the can filler. This sediment will accumulate and at times become loosened and go into the cans, causing bad ice. This condition is readily noticed when a can filler has not been used for a day or more. Then, when cans are filled without washing out the hose, there will be several blocks of ice with yellow or brown in them.

Before using a hose that has been idle, it is best to give it a washing by allowing the water to flow through for at least ten minutes. In some cases of this kind it is good practice to have an air connection so that air can be blown through the pipe lines and the hose to loosen this sediment so that water will carry it off.

The area of the suction pipe of a blower is the proper size, and any obstruction will prevent the full amount of air entering the blower. This means that the pressure inside the blower will be below that of the atmosphere. The partial vacuum in the blower case will suck the oil out of some of the bearings. This oil will pass through with the air and will make a yellow center in the ice cake.

Blowers that are equipped with silencers are often the cause of much bad ice. I have known of plants that turned out ice that had a yellowish streak in the center. The true reason for this discoloration was not found, and it was accepted that the water had something in it that could not be gotten rid of. Slight changes in the air suction overcame this trouble. It was really a case of the suction area being reduced.

Keeping the Spots Off the Ice Cake

By W. S. Hobbs

LITTLE information is available on the subject of air agitation, spotted ice or the formation of what I have chosen to call "flash ice" because of the manner in which it forms.

A plant under normal operation has but little, if any, trouble from the formation of flash ice, due to low brine temperature and normal agitation. However, in plants operating with high brine temperatures this phenomenon of flash ice occurs frequently. The greater the agitation the more likely is it to occur.

Fig. 1—A block of clear ice made with low-temperature brine and no agitation

Just as under certain conditions the temperature of water can be raised above the boiling point corresponding to the pressure over the surface of the water before boiling will start, it likewise can be cooled below its freezing temperature when out of contact with ice, before freezing starts. This is accomplished in an ice can with high brine temperatures or violent agitation, or a combination of both. The higher the brine temperature the lower the degree of agitation necessary to cause this subcooling below freezing. The nature of the surface on which ice forms appears also to affect the initial formation of ice. The effect of surfaces has not been determined satisfactorily. Water thus subcooled exists only in an unstable molecular state. As cooling continues, this unstable structure breaks down, and almost instantaneously a mass of flat flakes of ice comes into existence. I have been successful in obtaining temperatures on accurate thermometers lower than 31 deg. F. and I believe, judging from the amount of flash ice formed, that in some cases the temperature might reach even 29 deg. F.

Instantaneously with the formation of this flash ice, the temperature returns to 32 deg. F. and remains there during further freezing. This flash ice continues to roll around in bunches, interferes with the agitation, attaches itself to the surface of the solid ice, causing a rough surface which collects the solid matter and gases as they freeze out of solution and thus causes the spots in the ice. These spots are usually limited to the outer surface of the block and seldom extend in farther than an inch and a half, as by that time the flash ice has usually melted or attached itself to the solid surface.

This flash ice can be prevented by using a low brine temperature and moderate agitation or little agitation when the brine temperatures are high, until a film of ice has been formed on the can. This film does not affect the ice as it is so thin that it all melts when the can is being thawed. If no agitation is used, this film of ice can be formed with the temperature of the water in the center of the can far above 32 deg. F. In fact, it should be several degrees above in order to prevent the formation of icicles.

How to Eliminate the Flash Ice from the Ice Can

In a case where the film of ice is thin and where the average temperature of the water in the can and the brine temperature are high, the agitation, when started, may completely thaw this thin film of ice by bringing the warm water into contact with it. However, so long as this film remains until the entire mass of water has been cooled to 32 deg. F., ice will form only on the cold solid surface of this ice and no subcooling will take place, and thus no flash ice will be formed.

The illustrations are of two blocks of ice which were frozen side by side in the same tank of an Arctic-Pownell raw-water ice plant and consequently with water of the same analysis. This tank was cut into circulation without air agitation. The brine temperature reached 25 deg. F. before the film of ice was formed. In the spotted block, Fig. 2, the ice film did not form prior to starting the air agitation.

Fig. 2—A cake of spotted ice in which the flash ice was produced by agitation

Previously, this same tank had been cut into circulation with the same brine temperature, with air agitation and with the same water, and the formation of flash ice occurred in practically every can. This ice was then thawed by circulating warm brine. When the temperature of the water in the cans had been returned to about 40 deg. F., it was cut in without agitation as herein described.

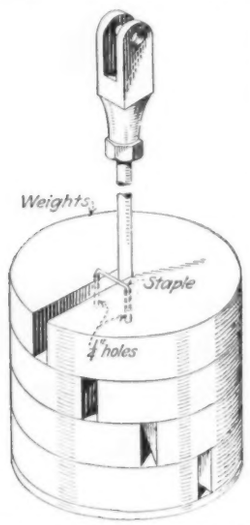
This formation of flash ice may explain the difficulty many ice-plant engineers have with bad looking ice. Of course, where the ice is used for car icing or other non-competitive lines, the appearance of the spotted ice is of no serious concern. The advent of the household ice machine, however, has made the housewife highly critical of the ice delivered by the peddler.

IDEAS FROM PRACTICAL MEN

For the exchange of practical information and ingenious expedients in operation and maintenance of plant and equipment

Securing the Counterweights on Regulators and Other Controls

PRESSURE regulators and other apparatus which have a number of slotted weights hanging from the end of a beam, constitute somewhat of a hazard, especially where the weights are overhead and persons may pass beneath them. In order to make this condition less hazardous, a safety device was applied which does the trick very well. Two ¼-in. holes were drilled in the top weights and a staple of $\frac{3}{16}$-in. steel rod was made to fit into them. This closes the slot so that the top weight cannot move sideways nor work itself off, and in doing this the under weights will be held in place and cannot be knocked off.



Staple in top weight prevents weights falling or being knocked off

The staple should be made to fit easily into the holes. Several of the top weights may be drilled and the same staple can be used on any one of them if the holes are drilled the same distance apart.

A safeguard, such as illustrated, is especially advisable on regulators or controls that tend to hunt or pulsate frequently and where workmen are required to carry lengths of pipe or other materials beneath them and may possibly dislodge some of the weights.

F. R. RAWSON.

Denver, Colo.

Air Hose Should Be Grounded When Used to Clean Pulverized-Coal Equipment

MOST engineers are familiar with the possibility of static arcs being formed by fluids and gases passing through ungrounded non-metallic hose. Frequent gasoline explosions demonstrate this most prominently.

Although I was well aware of this hazard, I, like many others, neglected to give it much thought until I drew an arc which I fully expected would blow the plant up.

One of the screen-type coal-pulverizing mills was to be opened for its periodic inspection. I had found from experience that when the inside was thoroughly cleaned with the air hose, there was practically no dust caused around the plant when the casing and screens were removed. To do this cleaning, we use 80-lb. air on a 1-in. heavy rubber hose bushed at the outlet to take a 3-ft. piece of ¼-in. pipe. When the hose is inserted through the 10-in. manhole in the top of the mill and a strong flash-light is used, this combination does a good job.

Recently, when I was blowing out the mill, the first few minutes the dust was pretty thick, and it was during this period that the 3-ft. nipple, free from metallic contact at its upper end, was swung fairly close to the protecting screen and an arc was formed.

Although the expected explosion did not occur, I quit blowing immediately and decided to provide a safeguard before proceeding further with the cleaning. I soldered a loop to the brass hose connection and attached a length of light chain to it, and to a spring clamp on the other end of the hose, which was fastened to a good ground before using any more compressed air on pulverized-coal equipment.

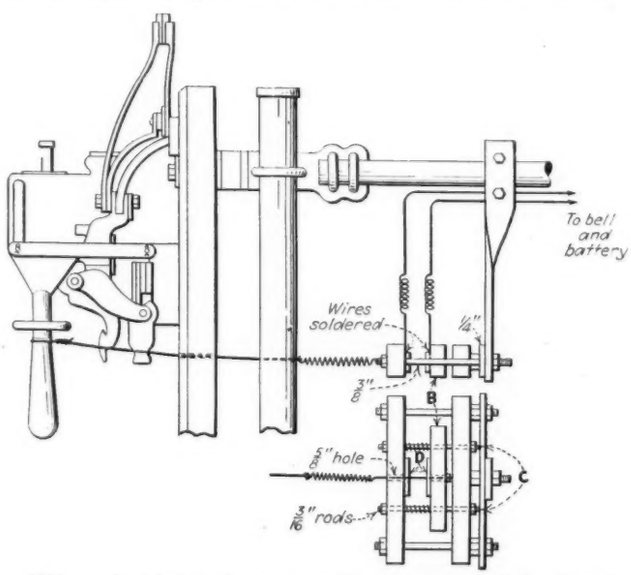
E. S. WOODWARD.

Sanford, Me.

Circuit-Breaker Alarm-Switch

IN THE plant where I am employed, the engineer on nightshift, besides operating the rotary converter and watching the circuit-breakers, also takes care of the boilers in an adjoining boiler house. It sometimes happened that a circuit breaker released while the engineer was in the boiler room, and as there was nothing to indicate the position of the circuit breaker without looking at it, some kind of an alarm was necessary.

Our electrician designed and built the alarm switch shown in the figures. As can be seen from the plan view on the lower right, the switch consists of a crossbar *B*, which is guided on two rods. This bar is connected to the lever on the circuit breaker. When the breaker is released, the lever moves to the left and closes the two contacts *D* on the switch.



When circuit breaker opens the alarm switch is closed

The two springs on the guide rods *C* should have only sufficient tension to open the bell contacts when the circuit breaker is closed. This switch has given good service, and the bell can be heard by the engineer in any part of the plant.

A. LEKSTROM.

Ironton, Minn.

Drive for Engine Generator Set Exciters

WE HAVE somewhat unusual exciter drives on our two engine generator sets, one 93.7 and the other 100 kva., installed in 1926 and 1927 respectively. These generator sets are in an engine room which, while not badly crowded, has no space to be used unnecessarily. Therefore we wanted to have the exciter drive taken off

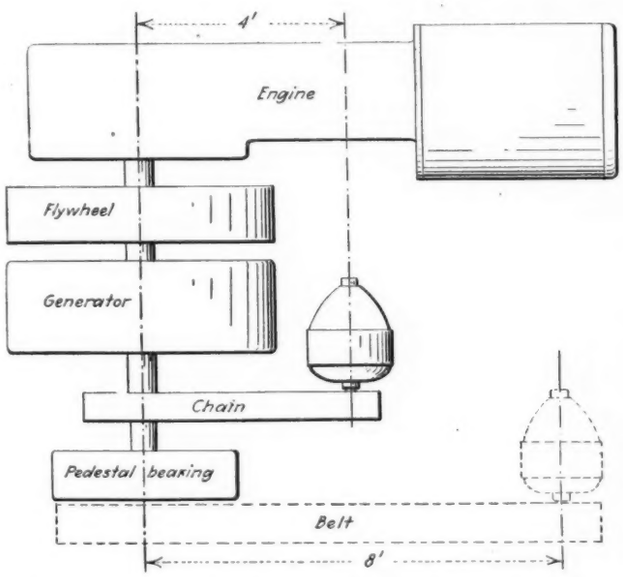


Diagram comparing chain and belt drives for exciters

the engine shaft at a point between the generator and the pedestal bearing in the space reserved for sliding the generator stator to one side of the rotor in case of necessity. This necessity has never occurred with us in the eight years we have been operating generator sets. The engine people suggested further that we use a chain drive instead of a belt drive, to which we readily agreed.

The chain drive, located as described, reduces the overall width of the unit about a foot and saves a considerable amount of floor space in front of the pedestal bearing and to one side of the engine, as shown in the diagram, in which the belt drive is indicated in dotted lines and the new chain drive in solid lines. After we had operated the chain drive on our newer unit for a sufficient time to prove its worth, we replaced the belt drive on our first unit with a chain drive, without encountering any difficulties whatsoever or making even a slight alteration elsewhere on the unit. If it should become necessary to move the stator to one side of the rotor, it is a simple matter to remove the sheet-metal casing which incloses the chain drive, and the chain. The stator has plenty of clearance for sliding over the sprocket on the engine shaft, although this split sprocket may also be easily removed, if necessary.

A comparison of the chain and belt drives may be summarized as follows: The chain drive is more economical of space, has a lower first cost, is cheaper to maintain, has a longer life, is more efficient, and is more reliable than the belt. With the belt drive there was belt slipping and tightening to contend with and the necessity from time to time of shortening and regluing the belt when the stretch was more than could be taken up on the exciter slide rails. We felt it advisable to have a spare belt on hand at all times for an emergency. With the engine turning "over," as is desirable, the tight side of the exciter belt is on top, which is not desirable; although matters can be improved with the use of a belt tightening idler. The chain drive cost us about $110 and the belt drive about $135, not including labor for installating, which was about the same in each case. In parallel operation of our two units there would be more danger of something going wrong with a belt, thereby throwing an excessive load on one generator, than is the case with the chain.

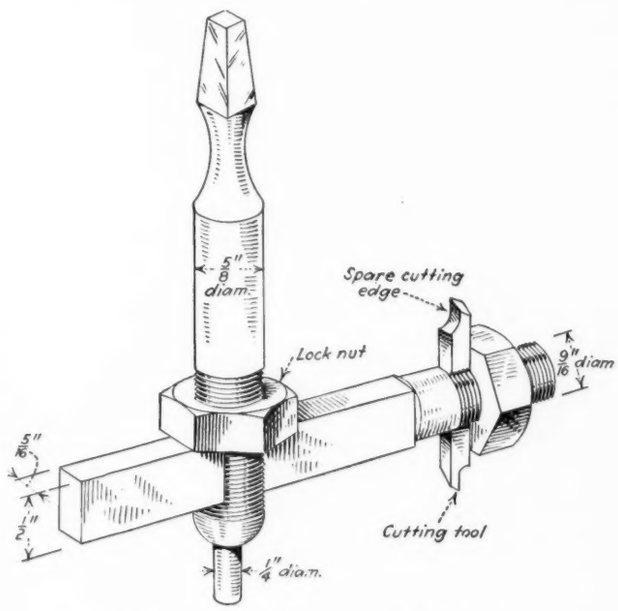
G. E. LEAVITT, JR.

Bayonne, N. J.

Tool for Cutting Holes in Sheet Metal

THE illustration shows a tool for cutting various sized holes in sheet metal, which is easily made and makes a clean-cut hole.

The shank is made from a piece of $\frac{5}{8}$-in. round steel, forged at the upper end to fit a brace or the chuck of a slow-speed drill. The other end is turned down to $\frac{1}{4}$ in. to form a guide and then threaded to take a $\frac{5}{8}$-in. locknut A rectangular opening $\frac{5}{16}$x$\frac{1}{2}$ in. was cut through the shank to take a cutting tool bar made from a piece of $\frac{9}{16}$-in. round steel, the portion which slides through the opening in the shank being shaped to approximately $\frac{5}{16}$x$\frac{1}{2}$ in. The tool was held in the crossarm by means of a locknut as shown. The cutting tool should be ground



Tool gives a clean-cut hole in sheet

as shown in the sketch, so that the outer edge will cut through first, thus leaving a clean-cut hole in the sheet. The cutting tool is made from $\frac{1}{4}$-in. square high-speed steel.

To use the tool a $\frac{1}{4}$-in. hole is drilled or punched in the sheet, the cutting tool is set at the proper radius and the locknut on the shank tightened. The guide point is then inserted in the hole and the tool turned by a brace or other means. All the parts of the tool are case-hardened.

W. L. STEVENS.

New Westminster, B. C.

COMMENTS FROM READERS

In which those who agree and those who disagree, with either authors or editors, are afforded an opportunity to express their views

Suggested Name for the Unit of Evaporation

SOME time ago I read a short editorial in *Power*, in which it was pointed out that a short name for the boiler unit of evaporation would be of considerable help. I understand that the term "Liric" has been suggested by the N.E.L.A.

My suggestion is to call the unit a "Bute." This is a short abbreviation of the first letters of the words, or perhaps some different spelling would be better, for example, "Beaut."

WM. JAY DANA,
Prof. Experimental Engineering,
Raleigh, N. C. North Carolina State College.

* * * * *

Figuring Depreciation

THE letter by J. O. G. Gibbons in the May 8 issue, on "Figuring Depreciation," demonstrates the inconsistencies in the commonly accepted formulas for estimating the carrying charges to be made against buildings and machinery. To illustrate his point, he assumes a building with an estimated life of fifty years. One formula adds to the interest charge of 6 per cent an annual depreciation charge of 2 per cent, obtained by dividing the first cost by fifty. This is obviously incorrect, and the total carrying charge is too high.

The other method uses the same depreciation charge—that is, 2 per cent—but figures a reduced interest charge according to the well-known formula,

$$\textit{Yearly interest charge} = \frac{M+1}{M}\left(\frac{\textit{Interest Rate}}{2}\right)$$

in which M represents the number of years' life. In the given example this yearly interest charge works out to 3.06 per cent, which, with the 2 per cent depreciation, makes a total charge of 5.06 per cent against the building. Thus the charge against the building, which depreciates, is less than the charge against the land, which does not depreciate and which bears the full 6 per cent interest on its first cost.

In view of the absurdity of these figures, Mr. Gibbons asks for a simple but more consistent method.

Why not go back to fundamentals and give logical meanings to interest and depreciation charges? The money that is spent to acquire land, building or equipment may logically be considered as having been obtained by issuing bonds that mature at the end of the estimated life span of the property. The interest charge is then simply the interest on these bonds, which in the example used would be 6 per cent, fifty-year bonds.

How are these bonds going to be paid off at the end of the 50 years, when the property they represent is no longer of value? That is the function of the depreciation fund, which may be considered as a savings account that is gradually built up by regular payments made to it throughout the 50-year period.

How much will we have to pay into this savings fund annually in order to have $100 at the end of 50 years? It depends entirely upon the interest that the savings fund earns. It if earns no interest, we shall have to put in $2 each year. However, if it earns 6 per cent interest, which is the same rate we paid for the money we originally borrowed, an annual payment of only $0.344 will build up the savings fund, or the depreciation account, to $100 at the end of fifty years. In other words, the annual depreciation charge will be 0.344 per cent, making the total carrying charges on the building 6.344 per cent.

The 0.344 figure is called an "annuity" and may be easily obtained from the annuity tables that are published in all engineering handbooks; these include all rates of interest and numbers of years. This method of figuring carrying charges is not an approximation like the empiric formula quoted above; it gives exactly the correct charge and may be applied without difficulty to any combination of interest rates and period of life.

EDGAR J. KATES.
New York City.

* * * * *

Treatment of Evaporator Feed Water

DURING the last few months there have been several discussions in *Power* relative to the treatment of evaporator feed water, and several viewpoints have been brought out.

It is felt that there should be no opposition to chemical treatment of evaporator feed water in view of the advantages to be gained. The treatment, however, must be reasonably cheap as well as effective. The principal advantage to be gained is the prevention of scale formation not only on the heating surfaces, but also in the brine or blowdown lines and in the brine pumps. This reduces or entirely prevents the labor of scaling with consequent wear and tear on the installation and the loss of time when the unit is inoperative.

Some statements have appeared, questioning the necessity of feed-water conditioning. The self-scaling feature of various designs and the periodic reversal of effects in multiple-effect plants might appear to solve the question of scale. They are not, however, entirely effective, especially when evaporating sea water in low-pressure plants. Forced scale cracking by the sudden admission of live steam to the coils with the shell full of cold water is another method of combating and removing scale once it is formed, but this method is also ineffective and, like the periodic reversal of effects and the periodic blowdown methods, requires anywhere from ten to twenty-five minutes' loss of time; and there is also an additional loss because it requires at least twenty minutes more before the plant has again steadied down to normal output conditions. Furthermore, the smooth, steady operating conditions conducive to best operating efficiency in the whole power plant, are interrupted each time, but in large stations this disadvantage may be negligible.

A recent discussion stated that scale caused no heat loss. This is not strictly true, for with increase of scale the capacity decreases, but the radiation losses remain the same. Hence, for a smaller output the same waste losses occur as for normal output. If, on the other hand, the

steam pressure is raised in order to maintain normal capacity as the scale increases, the condensate from the coils will leave at a correspondingly higher temperature and there will be some additional losses from this piping and the steam heads, even though the hot condensate is utilized for feed heating or returned to the feed tank. Incidentally, scale forms more rapidly as the temperature increases. In the low-pressure evaporating plants operating on exhaust steam, it is generally impracticable to raise the exhaust-steam pressure to compensate for loss in capacity, and hence to maintain a constant output the heating surface must be kept free of scale at all times.

Briefly, any heat-transfer apparatus will not operate at its maximum efficiency unless the heating surfaces are free of scale, films, dirt or other matter foreign to the medium being heated. In an evaporator it is believed that scale can be prevented with proper control of the feed-water condition by using some chemical such as sodium silicate and using a constant blowdown (or constant brining) to keep the concentration of scale-forming salts below that which will cause scale. T. A. SOLBERG.

Annapolis, Md.

* * * * *

Is Spare Equipment Worth the Cost?

THE editorial in the May 1 issue on this subject raises an extremely interesting question. Every designing engineer in a production organization where design work is scheduled, knows that he is more highly regarded if he meets a date as per schedule, than if he delays the job a few days for improvement changes that may save a considerable sum of money in production. He knows that if he continues to meet his dates regularly, with designs that will function, they will be accepted in the ordinary course of events without question. But let him display the courage to hold back the job because, after it is finished, he sees a way to alter the design to facilitate shop production, and everyone will jump him. Only after a long and strenuous argument, which is so much "waste motion," will he even be able to justify himself, despite the fact that he is saving real "dollars and cents."

So it is with the plant engineer—a breakdown is the signal for everyone in the organization to rave and raise a hue and cry for his scalp. Unless he is extremely courageous, like his fellow design engineer, he is inclined to play the game and give them "what they think they want." In his case it means 100 per cent continuous service at an extremely high insurance premium represented by the investment in spare equipment. These same spare equipment installations, often put in against his better judgment, are all part of the code of the "efficiency experts." These experts often install numerous paper-work systems as a matter of convenience in gathering statistical information, without ever questioning that while the information is interesting and convenient, it may not be worth the actual money expended in gathering and compiling it.

There is also this additional factor to support the engineer who believes there is a limit to the anti-breakdown insurance, and that is, it is human nature to be just a little negligent of the "service" on equipment when it is known that a shutdown of a given machine merely means starting up a spare, in contrast with the careful service rendered an installation where a breakdown means a serious tie-up. The apparent pinch-hitting ability of spare equipment is greatly minimized when it is definitely known that there isn't any spare equipment to fall back on. It is safe to predict that the tie-up on regular equipment will be only one-half that experienced when spares are available, when the men know that there are no spares to revert to, and that regular equipment must be kept up to the top notch at all times.

So, while I believe there is a nice point in engineering judgment to be faced in every plant installation, I think it should be left to the engineer to decide. And if his decision means a rare but occasional tie-up, he should be given the opportunity to analyze the situation in dollars and cents, before he is generally condemned.

Oaklyn, N. J. WILLIAM T. VAN HORN.

* * * * *

Reducing Power Costs by Co-operative Interchange of Power

INTERCONNECTION to enable more efficient use of generating units falls into the following fields:

(*a*) By interconnection and use of plants in the same system. This may include steam plant of varying efficiency, oil-engine plants and hydro-electric plants. In a large system a careful analysis of loading conditions and a proper control will make it possible to secure an approximation to the most economical loading for such groups of plants.

(*b*) By means of interconnection with other public service plants in the same or adjacent locality. By this the amount of power available for distribution is increased and, as in most cases, the peak loads for the several services do not coincide; a more even power load can be carried.

(*c*) By making arrangements for interchange of power with large industrial concerns which have large power plants well suited for linking up with the public service distribution systems. In this case, also, the ability to even out the load and to secure the use of efficient plants at times when their full capacities are not required by their owners, will tend to reduce costs and give more reliable service.

(*d*) By making arrangements for interchange of power in smaller plants, who are customers but who also generate their own power to some extent. In this field the interchange would be made only where conditions would make it mutually attractive.

If one could visualize the possible effect of a full development of such interchange of power, it would be manifest that the community concerned would benefit materially. Were it carried out to its logical conclusion, we might find that:

(*a*) The total power needs of the community could be handled with improved reliability by a marked reduction in the equipment.

(*b*) The more efficient plants would be used as far as possible.

(*c*) The least efficient plants would be discontinued.

(*d*) There would be a special stimulus for individual establishments to provide themselves with sufficient plants, because, if they could dispose of their surplus power, the extra capital charge would be justified.

The tendency would therefore be that the community would have (1) to support a less total capital investment in power generators, (2) receive the benefit of having their power generated by the most efficient plants available, (3) secure greater reliability and have less reason to maintain stand-by plants.

The success of an endeavor to thus fully utilize the power sources of any general locality will depend upon co-operation. The public service corporation must have in view not only the advantage to itself, but also the interest of the consumer and the individual disposer of power.

The success of such a plan depends upon mutual understanding, a civic spirit and a willingness to help others by helping yourself. The public service corporation must have in view not only the advantage to itself, but also the interest of the consumer and the individual disposer of power. It can devise the ways and means for putting the plan into operation and supply the proper control for the utilization of the power available, so that the best combined advantage can be secured. The proper exercise of this control is the key to the whole problem.

The use of hydro-electric plants in connection with steam plants offers opportunities to make material savings, and in certain localities a Diesel engine unit may be helpful to take care of peak loads or very light loads. The capital charges on a Diesel and the operating expenses may often be less than those of a steam plant. A kilowatt-hour can be delivered on 0.6 lb. of oil. When standing by, the oil engine requires no attention and consumes no fuel. Therefore, for erratic peak loads of relatively short duration it can be started and stopped more cheaply than boilers or generators can be taken off and on. The oil engine may also be found more economical than pushing boilers or generators at overload or at uneconomical rates.

Where coal is cheap, the oil engine is usually not the machine to take the base load, but it has possibilities in stand-by service and for peak load service. For small power plants the oil engine will generate power cheaper than the steam plant.

Certain manufacturing establishments, especially large steel works, have possibilities for developing power as a byproduct, as from blast furnace gas, used either under boilers or in gas engines. Their periods of heavy load in many cases do not correspond with those on the public service system. If these services are interconnected, the most efficient use of such byproduct power can be made in a way that may net a considerable profit both to the manufacturing establishment and to the public service company. In a few instances this has been done. It can be carried out more extensively to advantage.

Often generating capacity considerably in excess of the demands of the community has been provided. In such cases, directly or indirectly, the community pays the extra charge to provide these extra facilities. If care is taken to secure all possible out of the equipments at hand, and these are interconnected and controlled, there will be less chance of having power facilities either under- or over-developed and the new plants will then be gradually built in an orderly manner to take care of increased power demand and to replace the plants that have become obsolete, worn out or uneconomical.

Assistance to Manufacturers

There is an opportunity for the public service companies to extend interconnection and the use of surplus power from manufacturing power plants by providing a means and an incentive for the manufacturers to improve their wasteful plants. The public service company usually has the engineering force to make a study of any particular plant and to indicate the manner in which it could be renovated so as to give better returns. In this way the inefficient plants will gradually be scrapped, indifferent plants that have possibilities will be improved, and there will then be a tendency for the community to utilize the plants that are the most efficient. By assistance in financing improvements in power plants which have good possibilities, a very special service could be rendered. The public service company has the best possible information upon which to decide which plant and just how any particular plant should be modified to obtain the most economical results for interconnection with its own system.

Quoting from a Geological Survey Report in *Power*, Oct. 11, 1927, "The consumption of fuel by electric public utility plants would be reduced one-half if all electricity were produced at the best fuel rate," and the attainment of this efficiency would have saved about $75,000,000 in 1926. Through interconnection and effective control of the various power generating units a very appreciable part of this $75,000,000 could have been saved to the Nation. There are millions in it for the people, even if we only go part way.

Annapolis, Md. H. C. Dinger,
Captain U. S. N.

Answers to "What Do You Know"

The questions are on page 1139

Ans. 1—Yes, Dr. Diesel's original patents covered the use of coal, but the first successful engine was built in Germany in 1923.

Ans. 2—Without piston-water cooling, higher m.e.p. produce excessive piston temperatures; consequently 45 lb. m.e.p. is a usual value in such engines.

Ans. 3—Since both cylinders of the tandem are connected to one crank and the variation in turning effort is greater, the tandem should have the heavier flywheel.

Ans. 4—The usual method is by steam. Other methods include air jets, water jets, and a shotgun loaded with small shot.

Ans. 5—The discoloration may be due to organic matter in the water, rust from the piping or oil from the air compressor. There are many other causes.

Ans. 6—Yes, a round tube will work.

Ans. 7—Yes, the air is heated by the hot gases from the engine, so that even allowing for the friction losses, there is more power obtained from the air than is delivered by the engine belt wheel.

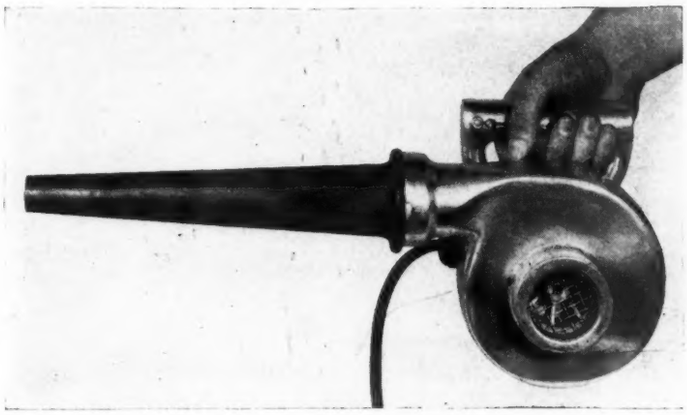
Ans. 8—No. Usually, the buckwheat carries a greater percentage of slate, etc.

Ans. 9—A trickle charge is one given continuously to a storage battery to maintain it in a charge condition, so that it may be ready to go into service at any time. A trickle charge should be made at a rate equal to about 1 to 1.5 per cent of the eight-hour discharge rate. The former is used where the room temperature is below 80 deg. F. and the specific gravity of the electrolyte is 1.200 to 1.250. If either room temperatures or the specific gravities or both are higher than these values, the higher rate of charge is used.

Ans. 10—A dynamotor is a combination of motor and generator in which both armature windings are on the same core. There is a commutator at each end of the armature, one for the motor and the other for the generator winding. The machine has only one set of field poles, the same as a motor or a generator.

PLANT EQUIPMENT NEWS

New and improved equipment in power and industrial plant fields, and new applications of existing equipment



Portable electric blower equipped with ⅓-hp. universal motor

Improved Type of Blower and Vacuum Cleaner

AN IMPROVED type of portable electric combination blower and suction cleaner has recently been placed on the market by the Ideal Commutator Dresser Company, Sycamore, Ill. Through improvements in the blower and motor to increase their power and a number of attachments, the new blower has been adapted to a wide range of cleaning around industrial plants.

This blower is adapted to blowing the dust out of machines, or a dust bag may be attached and the device used as a vacuum cleaner. The special attachments allow cleaning in confined places and on all kinds of surfaces.

The blower may also be used for spraying application, such as varnish on electric machine windings. Another combination is in conjunction with an electric heating unit for blowing heated air for drying purposes. Operation is on power that can be taken from any convenient lamp socket or outlet.

One of the advantages of portable blowers over the use of compressed-air lines is that the blower insures dry air, where there is danger of water being intrapped in compressed-air lines and carried out through the nozzle. A portable electric blower can be made available wherever there is an electric outlet where compressed air must be piped to the place it is to be used.

These new blower and suction cleaners are equipped with a ⅓-hp. universal motor and may be had for operation on 100 to 275 volts direct or alternating current.

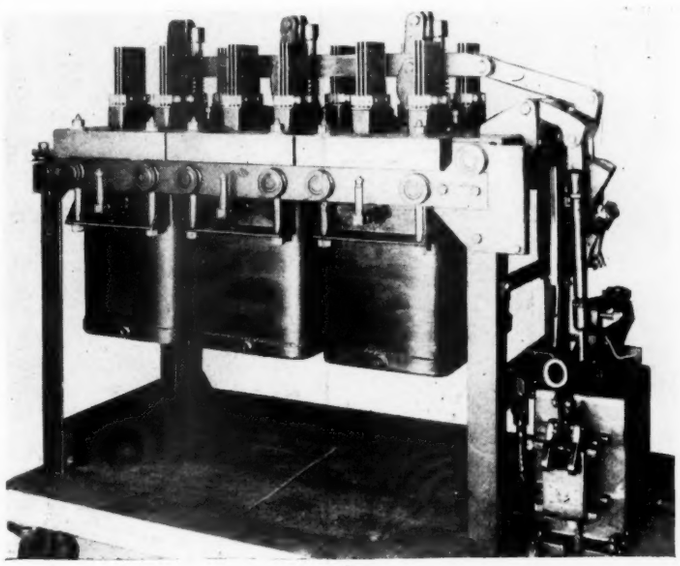
New Oil Circuit Breaker for 2,500 Volts

THE Westinghouse Electric & Manufacturing Company has developed an oil circuit breaker which is adapted for service where a relatively compact unit for heavy alternating current at 2,500 volts or less, is required. The breaker is self-contained, the pole units, operating mechanism and control panel all being carried on a steel structure arranged to mount on and bolt to the floor. The tanks can be lowered to the floor and removed from either side of the breaker. Current-carrying studs are arranged for direct bolted connection to the buses.

The standard arrangement for operating the breaker is by an electric solenoid mechanism. The pole unit tops are of slate, cushioned on felt and they are bolted to the breaker framework.

A tank is provided for each pole unit. The tanks are rectangular with flat bottoms and made of heavy sheet steel with the seams welded throughout. The current-carrying stationary parts of each pole consist of two groups of three copper bars, on the lower end of which is a heavy grooved copper block forming the stationary contact foot.

The stationary contact feet are fastened to the current-carrying studs. This connection is made by riveting and sweating the contact feet to the stationary current-carrying studs after they are fitted. The moving contacts are the semi-elliptical brush type, which make high-pressure wiping contact. Easily renewable arcing contacts protect the main contacts. The complete assembly of a 3,000-ampere breaker is shown below.



Oil circuit breaker for 3,000 amperes and 2,500 volts

Clarage Self-contained Oil-Fired Heater

THE self-contained, automatically-controlled oil-fired heater illustrated is a recent development of the Clarage Fan Company, Kalamazoo, Michigan.

The new unit, which is known as the Clarage McCann Harrison heater, is especially adaptable for industrial plant heating where a steam boiler plant would not be required for service other than supplying heat to the building and for installation entirely within the building to be heated. It is also adaptable as an interchanger for use where waste gases are available from kilns, furnaces, etc.

Referring to Fig. 1, the unit consists essentially of the fan *A* for supplying cold air to the heater, combined combustion chambers and heating elements *B*, oil burners *C* and oil-control unit *D*, together with the auxiliary control equipment mounted on the side of the heater. An auxiliary fan is also used to furnish the necessary draft and recirculate the products of combustion around the heating elements.

The combustion chamber, shown in the cut-away view, Fig. 2, consists of a heavy steel frame lined with special shaped refractory tile and fitted with two oil burners in one end, as shown. Air entering through special openings in the bottom of the chamber and through the burner plate, is heated by intermingling with the products of combustion and by radiation and contact with the hot tile walls. These products of combustion and air are mixed and distributed to the heating element above through a tile arch. The design of the combustion chamber is such that when running at rated capacity, the temperature of the heating gases entering the gas passages of the heating surface is 900 deg. maximum.

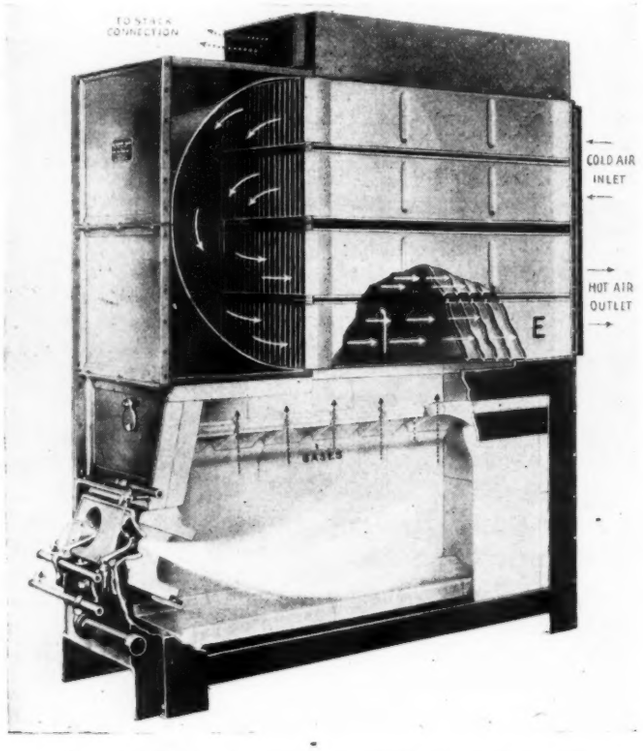


Fig. 2—Cut-away view of combustion chamber and heating elements

Each heating element (see Fig. 2) consists of a number of interlocked special shaped tubes of pressed ingot iron, vitreous coated. All joints in the tubes are welded or interlocked so as to be airtight. The heating surface in the elements is proportioned so that the required maximum air delivery temperatures are obtained with the gases not above 900 deg. F.

The burners are of the air atomizing type, using compressed air at 5 to 20 lb. pressure. The air is discharged through an orifice over the air nozzle, which connects through the burner body to the oil reservoir. The air passing over the nozzle produces a vacuum which draws the oil to the tip, where it meets the air jet and is

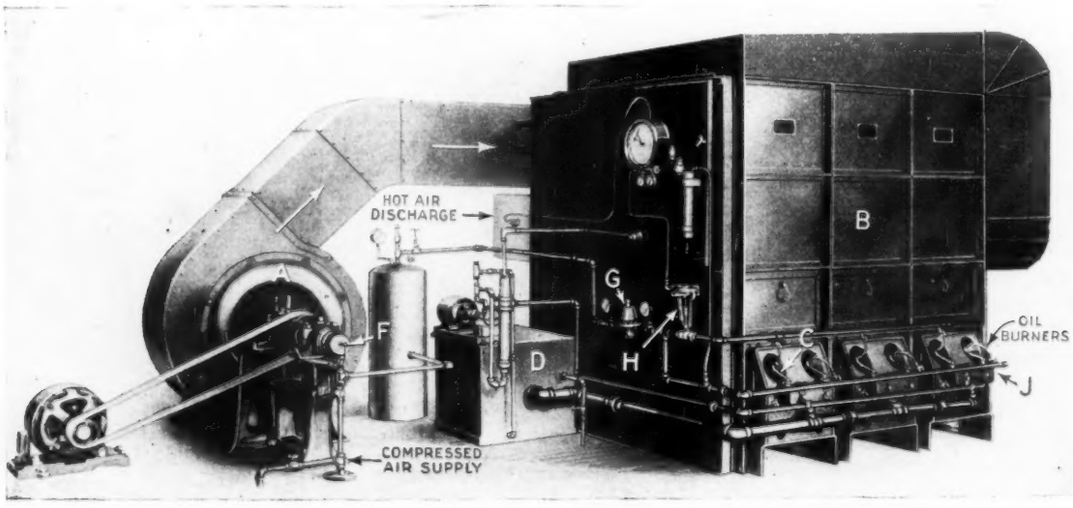


Fig. 1—Typical arrangement of a three-unit heater and auxiliary equipment

sprayed to the combustion chamber. Two converging burners are used in each unit, set on an angle with the floor. No needle valves are used on the oil system, and a fine-mesh screen of large area is used, so that the possibility of trouble from clogging is reduced to a minimum. Since the amount of oil siphoned through the burner is directly proportional to the amount of air projected over the oil tips, the capacity of the burner is readily controlled by varying the air pressure.

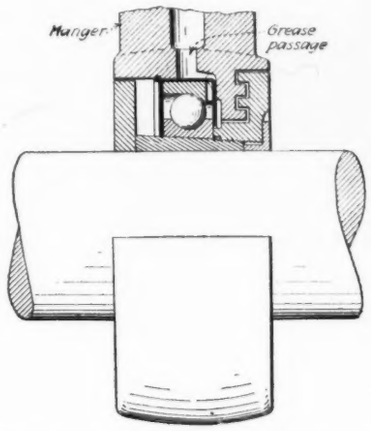
Compressed air for the burners is supplied either from the regular system already installed, or by an independent motor-driven compressor. An automatic governor *F* (see Fig. 1) driven from the fan shaft and operating a valve in the compressed-air line, serves as a safety governor to close the air valve whenever the fan stops, thus protecting the heater against excessively high temperatures. A pressure regulating valve *G* and a thermostatically controlled valve *H* are incorporated in the air line to the burners.

The oil control unit *D*, Fig. 1, consists of a welded steel tank, a float valve for controlling the amount of oil entering the system from the storage tank, a safety shutoff valve, and a motor-driven oil pump, which maintains a constant circulation of oil through the reservoir *J* on the front of the heater. The oil is pumped directly to the reservoir, and any surplus returns by gravity through the return pipe to the pump. Both the oil control and reservoirs are under atmospheric pressure.

The heater is also adaptable for practically all classes of low-temperature drying, delivering heat for this purpose at temperatures up to 200 deg. F. It is likewise available, completely equipped, for using gas instead of oil as fuel.

Dustproof Conveyor Bearing

THE Transmission Ball Bearing Company, 1050 Military Road, Buffalo, N. Y., has recently introduced the dustproof ball bearing and hanger illustrated. This equipment is designed primarily for use in spiral or screw conveyors, used in carrying dusty or abrasive materials. The bearing is fully inclosed and is protected by a labyrinth cap which fits on the material handling end of the bearing over a threaded portion of the adaptor sleeve. The ball races are entirely inclosed in a steel cap with a steel spring end-piece at one side, which maintains close contact with the ends of the races. Lubrication is introduced into the bearings through a pressure-type fitting and a passage drilled in the hanger. The hanger, made as an integral part of the bearing support, eliminates the necessity for U-bolts and simplifies installation. The design is such that the bearing is also said to be suitable for conveying hot materials in that expansion and contraction are provided for. Complete units are being built in sizes to fit the standard conveyors now in use.



Section of dustproof ball bearing for screw-conveyor shaft

New Stroboscope Uses Neon Lamp

AN ELECTRICALLY operated stroboscope for determining the angle of lag of synchronous machine rotors under load, has been developed by the General Electric Company. The new device, unlike earlier types of the stroboscope, employs no moving parts or tachometers. It operates by means of a small Neon-gas lamp, which gives flashes of light lasting less than one-fifty-thousandth of a second each, and thus illuminates a white line on a stroboscopic disk fixed to the rotor shaft of the machine under test, for so short a time that the line appears to be standing still. Fixed concentrically with the disk and just outside its circumference, is a stationary scale marked in electrical degrees, and upon this the white line acts as a pointer, giving a direct reading of rotor displacement.

In construction the stroboscope is simple. A black disk, 12 in. in diameter, is marked with a white line and is provided with a central hole for mounting on the machine shaft. A scale sector covering about 60 deg., is included for taking the readings. The neon lamp equipment is contained in a small portable box. One end of the box is open, and the neon tube is placed just back of the opening, flanked by three plane mirrors. The remainder of the box is occupied by a special transformer which furnishes 2,000 volts for lighting the tube. Condensers and switches are also mounted within the box.

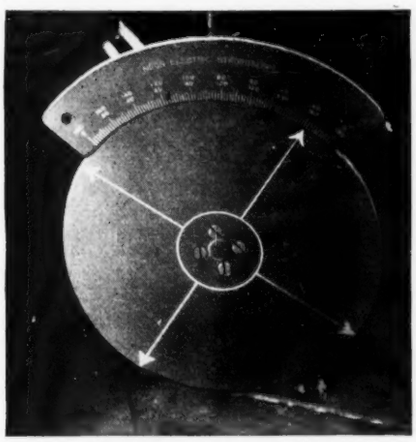


Fig. 1—Disk fastened to rotor shaft

In operation the transformer is connected to the same voltage source as the synchronous machine. The high- and low-tension windings are linked by a core of special transformer iron, which rapidly becomes saturated as the flux wave of each half-cycle rises from zero. As a result, an extremely sharp voltage peak is induced in the secondary winding, causing the tube to flash twice during each complete cycle. A filter system is used in connection with the lamp to suppress harmonics which would tend to give secondary flashes.

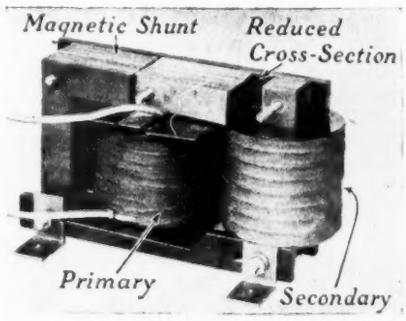


Fig. 2—Transformer used with stroboscope

Pulverized Coal in

Stationary Railway Power Plants—IV

The characteristics that should be looked for in a unit pulverizer are set forth in this, the concluding section of the report of the Committee on "Coal Fired Boiler Plants" of the American Railway Fuel Association. Operating figures of a typical installation are included. The previous sections were printed in the issues of June 5, 12 and 19, and together constitute the most comprehensive discussion on pulverized coal for the small plant that has yet appeared.

THE basis of the belief that the following characteristics are obtainable is that at least one present-day mill actually does that well in each respect. However, no one present-day mill combines all these features.

(*a*) A principle of pulverization making the mill reliable and unbreakable under normal conditions of operation. A mill having minimum outage.

(*b*) Conservative safety factors for operating stresses when using material obtainable at reasonable cost.

(*c*) Something more effective than a magnetic separator is required even for deeply buried magnetic material, while for non-magnetic material (wood, etc.) the magnet is of no value whatever.

(*d*) Accessibility, ease and quickness of renewal of wearing parts. Preferably wearing parts should be replaceable while mill continues in operation as in a tube mill. There are impact mills on the other hand that require the labor of two men for six hours to renew a set of hammers. Most of the present-day mills, however, can be rehammered in less than 30 minutes.

(*e*) Power consumption (total for mills and fan) not over 10 to 12 kw.-hr. per ton with 3,000 to 4,000 tons per set of hammers and fineness of 75 to 85 per cent through 200-mesh and ½ of one per cent over 60-mesh at or near full loads on 5 per cent moisture Eastern bituminous coal. The power consumption should be consistent and uniform in spite of wear on the grinding elements.

(*f*) *Flexibility.* Either a great range of closely graduated pulverizer sizes applicable to each more usual commercial boiler size, each mill giving an effective 4 to 1 range, or fewer pulverizer sizes with wider ranges (6 to 1, 8 to 1 or 10 to 1) are desirable. Most unit pulverizers control incoming air by throttling the air inlets to the machine. Such control tends to build up high negative pressures at the feeder, causing erratic feeding and irregular or pulsating combustion, particularly at low ratings.

(*g*) Present-day prices are too high. The average *good* unit mill installation complete should cost slightly less than a good stoker installation complete rather than somewhat more as at present. Thus fixed charges will be kept to a minimum. Extra service and engineering for those who need it should be charged to individuals who need more than the average and not prorated against general overhead.

(*h*) A non-sticking, flexible, uniformly dependable feeder assuring complete control on load variations is necessary.

(*i*) An easily controllable air inlet (preferably single) to make attainable, either manually or automatically, mill (primary) air ratios necessary for proper and consistent grinding.

(*j*) Consistent fineness. The effect of wear should not be such as to affect materially size and uniformity of the pulverized product nor the capacity of the mill. Most high-speed impact mills start out with a very fine grind, and as the hammers or paddles wear, the fineness decreases until wearing parts are again renewed. Tube mills and mills with classifiers inherently satisfy this requirement.

(*k*) A positive fineness control independent of the flow through the feeder.

(*l*) Uniform air distribution throughout the mill and uniform delivery of pulverized product to the fuel pipe and furnace.

(*m*) Fines should be immediately removed as produced, not only to prevent waste of power, but to avoid reagglomeration and the production of a flaky product.

(*n*) The mill should be easily and inexpensively adaptable for automatic control.

(*o*) It should lend itself to direct connection either with 60-, 50-, 40- or 25-cycle motors. Gears are noisy, subject to wear and costly as to power.

(*p*) The mill must successfully handle wet coal such as Illinois coals and Western lignites without plugging, serious loss of capacity, or fineness, or serious increase of power requirements.

(*q*) The mill should lend itself to the use of preheated air. The builders state that driers are unnecessary with unit mills. Some testify to having handled coals (lignite) up to 38 per cent moisture content as well as bituminous coals from water storage by the use of preheated air from hollow walls and floors or sometimes bled hot furnace gases. Though power consumption usually increases with wet as compared to dried coal, opinion is that the increased power cost is little to pay for the elimination of driers.

Preheated air minimizes this power increase. The builders recommend temperatures from 250 to 500 deg. F., without causing trouble. Hot furnace gases bled from the furnace bottom or boiler uptake should be resorted to only when sources of preheated air are not available.

(*r*) The mill should have maximum possible capacity obtainable in a given space (both as to floor space, height and cubical contents).

(*s*) It should be simple of operation.

(*t*) A maintenance guarantee of one cent per ton of coal ground on Eastern coals, and not over three to five cents on Illinois coals should be possible.

(*u*) The mill should have perfect balance at all times and be dependable and continuously free from noise or vibration.

(*v*) It should be cleanly in operation.

Coal Handling

In very small installations, particularly horizontal return-tubular boilers requiring less than a ton of coal per hour total, and where labor is cheap, there is an occasional instance where the expense of bunkers, coal-handling equipment and track hoppers may not be justified, but such occasions are rare. In such cases it is often convenient to set the pulverizer in a slight excavation in front of the boiler so that the coal can be shoveled into the pulverizer hopper with a minimum of lifting. In such cases a grizzly set over the pulverizer hopper will catch most of the foreign material which otherwise might clog the feeder or harm the pulverizer. A magnetic pulley or separator, in addition to the grizzly, is desirable with high-speed machines if not too inconvenient to install. Even on such small installations, a cheap rugged platform scale is desirable for measuring the coal.

With the exception of the very small installation, there is some type of coal handling, weighing and metering equipment sufficiently inexpensive for any installation. A one-car track hopper with conveyor equipment to overhead bins calculated on the basis of a 20- to 24-

The three fundamental requirements of the ideal unit pulverizer named in the order of their importance are (1) reliability (2) efficiency and (3) low maintenance.

hour supply will often permit all coal handling to be done on the light shift.

As to the hoppers and spouts, especially where high sulphur coal is burned, it is generally poor ultimate economy to cut corners too closely on thicknesses of materials used. As to conveyors and coal weighing or metering equipment, a prospective buyer is often agreeably surprised at the inexpensive yet reasonably effective equipment the market affords for these smaller installations.

Preliminary Crushing

Although there are one or two pulverizer raw-coal feeders on the market advertised to pass 4- to 6-in. lumps of coal, it is generally conservative judgment either to insure that "as received" coal will not exceed 1 in. to 1¼ in. in maximum size or to put in a preliminary crusher of some kind. In connection with a coal conveyor these can usually be inexpensively installed and are often good insurance against erratic feed and firing where coals of wide variance as to size may be bought. Generally, one kilowatt-hour per ton of coal crushed is ample for these crushers.

Just before the crusher is generally the best place to locate the magnetic pulley or separator, thus eliminating possible damage to the crusher, as well as obviating the necessity of small, expensive and less powerful individual separators with each pulverizer.

To reiterate, many successful installations are getting along without the equipment described in this section, but if large coal is encountered frequently, they might be still more successful over the average year's run with same available. Each case must be studied separately to see whether such equipment will be used often enough to justify its fixed charges.

Agglomerate, Wet and Abrasive Fuels

The worst single bugbear of pulverized-coal operation is wet, frozen or agglomerate coal. Even with preheated air (which never should be omitted in these days) mill capacities are cut down, feeding is less uniform and control generally more difficult—not to mention the additional moisture loss in the furnace.

Very abrasive fuels such as coke braize, river anthracite and some unusually hard bituminous coals, require special handling throughout the entire system. The number of such installations is too small to justify detailed treatment herein.

Boiler Meters and Control

The possession of a high-grade tool does not necessarily insure superior workmanship; nor can powdered coal prove itself superior to other firing methods even when properly applied, if proper instruments to check operations are not provided *and used* daily. For installations of the sizes discussed, proper metering equipment can be bought from $100 to $500 per boiler.

Ten years ago, particularly in the cement and metallurgical industries, there was a decided explosion hazard with powdered coal. Nowadays, if one will secure from the National Board of Fire Underwriters the latest issue of their booklet, "Regulations of the National Board of Fire Underwriters for the Installation of Pulverized Fuel Systems," as recommended by the National Fire Protection Association and approved by the American Engineering Standard Committee, and be governed thereby, no fear need be necessary in this connection.

To avoid misunderstanding, no attempt has been made to make comparison with what might be done with a new stoker installation. It is probable that at least a good portion of the savings could also be effected with present-day stokers, which would then bring the consideration back to a question of relative expenditures.

Subsequent to preparation of the main body of this report the Committee had the opportunity of investigating and inspecting the operation of an interesting unit pulverized-coal plant converted from hand firing and believed to be a typical example of such plant conversions.

The Dupont Viscoloid Company manufactures "Pyraline," an expensive product of cellulose. Production of this material requires extreme cleanliness throughout the plant. Slight particles of carbon or dirt entering the product will subject it to costly rejection. One of the principal initial problems therefore concerned possible emissions of dust from the stack of the power plant. The boiler room housed fifteen boilers ranging in size from 2,500 to 5,000 sq.ft. These were of the horizontal water-tube type and ranged in age from twelve to twenty years. All were equipped with hand-fired grates burning a mixture of anthracite and bituminous coal. The plant load averaged approximately 3,000 hp. total and with hand firing required from ten to thirteen boilers operating continuously. Extreme care was necessary in hand firing in order to minimize objectionable stack emission. An approximate daily efficiency of 70 per cent was shown with hand firing. Regardless of this rather satisfactory indication of operating performance the stack problem was still serious enough to necessitate consideration of other firing methods.

After careful investigation of numerous pulverized-coal installations, the engineers decided to equip a single boiler for experimental purposes to decide whether this method of firing would thoroughly fulfill requirements. In October, 1926, this company purchased one 4,000-lb. unit pulverizer to fire two 2,500-sq.ft. horizontal water-tube boilers designed for single furnace setting. The installation was completed in December, 1926. Extensive experiments resulted in a most favorable showing for pulverized fuel and at the same time satisfied the engineers that pulverized fuel was the most satisfactory solution in their case both for plant economy and the elimination of objectionable stack emission.

In July, 1927, this company decided to equip four more boilers with the same type of pulverizer, thereby carrying their entire plant load with pulverized fuel, with a total of five boilers so equipped. The installation of the additional pulverizers was completed in October, 1927.

The following comparison of operating costs was furnished by the Dupont Viscoloid Company.

MONTHLY COST OF HAND-FIRED BOILER OPERATION, JANUARY, 1927

Total steam generated for the month 67,866,365 lb.
Total fuel consumption for the month 4,640 tons.

	Total Cost	Cost per 1,000 Lb. Steam
(a) Fuel	$16,813	$0.2480
(b) Coal handling	805	0.0118
(c) Boiler-room labor	4,372	0.0645
(d) Maintenance material	200	0.0030
(e) Power for forced draft	900	0.0132
Totals	$23,090	$0.3405

MONTHLY COST OF PULVERIZER FIRED BOILER OPERATION, JANUARY, 1928

Total steam generated for the month, 58,326,000 lb.
Total fuel consumption for the month 2,975 tons.

	Total Cost	Cost per 1,000 Lb. Steam
(a) Fuel	$11,050	$0.1900
(b) Coal handling	515	0.0088
(c) Boiler room labor	2,400	0.0412
(d) Maintenance material	257	0.0044
(e) Power for pulverizer	657	0.0113
Totals	$17,279	$0.2969

The saving per 1,000 pounds of steam is $0.0436.

The saving of $5,811 per month being affected, totals an approximate yearly saving of $69,271. This company expects to pay for the total cost of equipping its boilers with pulverized coal in approximately a twelve months period.

A brief summary shows the principal advantages gained with pulverized coal over hand firing at this plant:

1. Ability to carry entire plant load with four boilers holding fifth as spare with pulverized coal compared to ten to thirteen hand-fired boilers with two to five as spares.

2. Reduction in labor from 36 men per day to ten men. This includes coal handling, firing and ash handling.

3. Ability of one stack to handle the plant load with pulverized coal compared to two stacks with hand firing.

4. Ability to pulverize and burn low grades of fuel with high efficiency as compared with the exact reverse with hand firing.

5. Clear stack emission.

6. Elimination of banking losses.

7. Utilization of oil boilers with comparatively inexpensive setting changes.

DIESEL ENGINEERS
Gather for PENN STATE *Conference*

THAT the technical divisions of the American Society of Mechanical Engineers are important functional parts of industry was proved by the successful Oil Power Conference held at the Pennsylvania State College, State College, Pa., from June 14 to 16 by the Oil and Gas Power Division of the American Society of Mechanical Engineers. This meeting was under the auspices of the College and the Central Pennsylvania Section of the Society.

The meeting was notable as being the first at which the most of the oil-engine builders ever presented and discussed the many angles of oil-engine development.

The opening session, on the morning of June 14, was called to order by Fred R. Low, the chairman, after which the visitors were welcomed by Ralph D. Hetzer, President, Pennsylvania State College.

In a comprehensive paper Oliver F. Allen, International General Electric Company, covered the present-day Diesel developments in Europe. The many slides he showed, gave the audience an illuminating picture of what the builders are doing. As he pointed out, the drift is toward the use of mechanical, or pump-pressure, injection systems in even the largest unit. On an experimental A.E.G. single-cylinder engine of 2,000 hp. the system operates satisfactorily. This same builder has in service an 11,000-hp. unit that has satisfactory combustion without the air system. Illustrations were shown of the 15,000-hp. MAN design air-injection Diesel in the Hamburg electric municipal light plant, and the speaker claimed that the engine lowered the total plant cost per kilowatt-hour by operating on the peak loads.

Other important steps in progress have been made by Beadmore & Company, in England, Mr. Allen stating that this builder's high-speed Diesel was notable for its many radical yet successful features. Other light-weight high-speed units of MAN, Krupp, Benz and Duetz makes were touched upon. It was the speaker's belief that high speed would be the chief characteristic of the future engine. Much of the European business is for export, South America taking a large number of engines ranging up to 2,000 horsepower.

At the afternoon session, at which Dean Sackett presided, H. A. Pratt, of the Ingersoll-Rand Company, read a paper on "The Economic Field for Medium Size Diesels."

The field of application of Diesel engines up to 500 hp., the speaker stated, was broadly divided into three classes: Marine applications, engines for automotive service and engines for stationary work.

High Points

Manufacturing and sales problems studied . . . Mechanical injection used for 11,000 hp. unit . . . Trend toward lightness and higher speeds . . . Demand for standardized Diesel fuel specifications . . . Standardization of certain engine parts proposed.

In the marine field the Diesel engine had quickly forged to the front; for example, over 50 per cent of the world's ship construction in the years 1926 and 1927 was equipped with oil engines. The ships that take the small units today were the fishing boats, tugboats, work boats, ferryboats, small lighters, dredges, yachts, coast patrol, etc. It is almost safe to say that no boats in this class are built without considering the use of a Diesel engine, as it shows in the majority of cases great economy over any other power.

Turning to a consideration of engines for automotive service, the speaker stated that attention was being given to the development of the Diesel engine for trucks and tractors, and even in the airplane field study was being given to the development of a proper Diesel engine. For locomotives, rail cars, shovels and dragline buckets a big start had already been made.

Several hundred Diesel-operated shovels and dragline units were built in the last year in the United States. While the cost of the Diesel engine was considerably more than that of the gasoline engine, the saving on the operation of 100-hp. units was approximately $1.50 an hour, and it was only a question of determining the number of hours the unit will operate, to show the advantage of the Diesel engine, it was claimed.

It was stated that of the prime movers in the country today about 40 per cent were installed in central stations and about 60 per cent in private plants. Great central stations were not users of Diesel engines on account of the sizes of the units, but for smaller plants and for reinforcing existing central station lines, the Diesel engine had been extensively adopted.

A paper by E. B. Pollister, Busch-Sulzer Brothers Diesel Engine Company, on "The Economic Field for the Large Diesel," was next presented by C. E. Beck. The author claimed that many of the medium-capacity central stations could be better served by Diesel engines than by steam units. It was conceded that in the Mid-West cheap coal made the large steam plants more economical than Diesel plants, but in the Southwest and along the Atlantic Seaboard there were many localities where Diesels would prove superior. It was the author's contention that a Diesel plant would cost but little more than a steam plant of like size. He was especially insistent that the Diesel was suitable for peak loads in existing steam plants and that it was logical to install oil-engine plants along the transmission lines of a large utility to eliminate much of the line loss.

In the third paper of this session, by Roswell H. Ward, entitled, "The Diesel Engine and the Public Utilities," a plea was made for better competitive conditions than exist at present between oil-engine salesmen and the public utilities. It was the speaker's idea that the public utilities offered the greatest market for oil engines and that Diesel builders should cultivate this rather than seek to enter the industrial field.

In the discussion of the three papers, Edgar J. Kates pointed out that if the public utilities made more equitable power and lighting rates, the cost of purchased energy for industrial plants would rise, making the factory Diesel plant the most economical source of power. Transmission losses would be avoided and the central stations would devote more time to the developing of a household ton.

H. C. Thuerk, Erie Lighting Company, stated that the public utilities were not fighting the Diesel as a competitive power. He believed that there were many places where it filled in. He did deplore, however, the lack of engineering done on many installations, and felt that more accurate operating cost records were desirable.

In the evening there was a "get acquainted" hour for the visitors and a second meeting at which the engine builders discussed the particular marketing problems of the industry.

The outstanding paper of the conference was that read by G. H. Michler, Standard Oil Company of New Jersey, on "Diesel Fuel-Oil Specifications," at the Friday morning session. The difficulty confronting the oil refiner was that of preparing small batches of fuel to meet widely varied specifications. This, the speaker stated, necessitated the multiplication of storage tanks and increased the manufacturing costs. As a result it was only a question of time until such Diesel oils would advance sharply in price.

The author expressed the belief that wide variations in the oil specifications issued by the several engine builders were not based on sound grounds. If the builder fitted his engine with the proper atomizer, pump, etc., it would handle almost any oil above 22 deg. Baumé. The restriction of the sulphur content below 1 per cent was unnecessary, and a permissible percentage of 1.5 was advocated. He recommended that the important specified characteristics be viscosity, flash and sulphur. With more liberal specifications oil prices would continue to be low for at least 25 years.

Diesel Fuels Discussed

Harte Cooke, McIntosh & Seymour Corporation, in discussing the paper, agreed that the specifications were too restricting. A viscosity of 25 sec. Saybolt furol at 60 deg. F., should be permissible, but more viscous oils were hard to force through pipe lines without heating. In addition the water content was of importance, as this might be salt water, of which the salt content would fuse on the exhaust valves. Just how poor an oil a Diesel user should buy depended upon how much maintenance could be permitted. In all events he thought a standardized fuel specification should be worked up.

W. S. Reynolds, Union Oil Company, Los Angeles, Calif., stated that the design of the engine largely determined the grade of fuel to be burned. For example, if a precombustion-type engine had a narrow orifice to the cylinder, the turbulence is not good and will not burn low-grade oil, while if the neck was large in diameter, oils as low at 14 deg. Bé. could be handled. It was also claimed that high-pressure solid-injection engines were sensitive to the oil characteristics.

Unless the spray nozles were changed, an engine would not handle oils of widely varying characteristics. He stated that engines would handle oils above the listed gravity as follows:

Air-injection engines	12 deg.
Precombustion engines with two nozzles	14 deg.
Precombustion engines with one nozzle	16 deg.
High-pressure solid-injection engines	16 deg.
High-pressure opposed-piston solid-injection engines	18 deg.
High-pressure solid-injection engines with open combustion chamber	22 deg.
Medium-pressure precombustion with small neck	24 deg.

Commander J. J. Broshek, U. S. Navy, stated that the Navy's oil specifications were derived from experience with 135,000 hp. of submarine Diesels. The Navy contracts for oils having the following characteristics: Flash, 150 deg. F.; water and sediment, 0.5 per cent; sulphur, 1.5 per cent; viscosity, Saybolt, 200 sec. at 200 deg. F.; ash, 0.1 per cent.

He stated that, formerly, the sulphur was held to one per cent, but this caused the price of the oil to be high. Existing engines handled the 1.5 per cent sulphur oil with satisfaction. Gravity was not a point of interest and the viscosity reading was used instead. The amount of ash was of importance, as the ash determined the amount of piston and lines wear.

O. S. Wiese, senior engineer, U. S. Shipping Board, stated that the problem was one for the builders to solve. At the last sitting of the board, the engine builders called for oils ranging from 16.5 to 22 deg. Baumé and from 56 to 1,000 Saybolt sec. at 60 deg. F. Sulphur ranged from 1 to 4 per cent, while the residue was from 0.5 to 35 per cent.

At the end of the session a resolution was adopted asking that the Research Committee of the Oil and Gas Power Division appoint a subcommittee to study the oil-specification problem.

At the afternoon meeting, of which G. W. Lewis, Director Aeronautical Research, National Council of Defense, was chairman, the desirability of research on oil-engine problems was outlined by Harte Cooke, McIntosh & Seymour Corporation. It was his opinion that there were many problems of material and design that could be solved through co-operative research. Just how this work could be supported was not given, but he felt it could best be done through a builders' organization.

Prof. P. H. Schweitzer, of Pennsylvania State College, outlined the work he was doing in "Oil Sprays Research." In the discussion R. J. G. Pigott, of the A.S.M.E.'s Research Committee, gave a brief description of how other research work was being supported. He felt that the A.S.M.E. could be depended upon to supply the initial fund, the balance to be raised among the builders.

W. F. Joachim, Langley Field, outlined much of the work being done on Langley Field's oil-engine research. He felt that some other agency other than the National Research Council must do the work on commercial engines.

Over 200 gathered at the banquet Friday night. Dean Sackett acted as toastmaster in introducing the several speakers.

L. H. Morrison, *Power*, spoke briefly on the advantage the conference was to the oil-engine industry. Unlike the meeting of the previous year, most of the engine builders were represented at this second annual conference. He made a plea for closer co-operation among builders and a better study into marketing.

O. F. Allen, the next speaker, spoke of the influence of the Diesel Users' Association in England upon the improvement of the oil engine. He also outlined the studies made by Germany in the expansion of its Diesel industry.

The principal speaker of the evening was George Heath, Carels Diesel & Steam Engine, Ltd., of London, England. Mr. Heath is on his way to England after visiting the Far East and Australia. He gave his listeners a graphic recital of power conditions in these far countries and felt that much of civilization in the Far East was due to the oil engine. His principal theme was the advantage of co-operation among the Diesel builders and among users.

The final session, on Saturday morning, was devoted to the problems of specialization of engine parts.

A paper by O. D. Treiber, on "Specialization from the Viewpoint of the Oil Engine Builder," pointed out the advantages to the engine builder brought about by purchasing parts from outside machine shops. It was his belief that by proper study such parts as piston rings, bearings, pump valves and other small parts on engines of various makes could be standardized to permit mass production by a specialty shop.

Progress in the Diesel-engine building art had been rapid in the last few years, but production would never be as intensive as the automotive business, so he felt. However, specialty shops could contribute their portion to the economies of Diesel construction in maintaining a high-class organization of mechanics who were taught to do different kinds of jobs economically. This policy was of necessity exercised in the Diesel manufacturer's shop because of the lack of high production of any given size, and if it could be worked out efficiently in the builder's plant it could also be done in the specialty shops. Citing as an instance, the matter of spray nozzles, he stated that there were probably 25 different kinds of spray nozzles today built in as many different shops.

Standardization of Parts

"Manufacture of Diesel Fuel Injectors" was the title of a paper C. R. Alden, Ex-Cell-O Tool & Manufacturing Company. He outlined what his company was doing in the manufacture of fuel pumps for various manufacturers. Unfortunately, each builder had his own design, and advantage could not be taken of non-productions. The speaker pointed out that these designs were not always the best and could be improved upon by proper study. His company's research had revealed in respect to pump plungers and bushings, that straightness and roundness and a very small difference in diameter allowed free mechanical motion; the length of carefully fitted parts had little to do with their tightness against air pressure or light oils and the length specified for fitted parts to prevent leakage at high pressures need not be greater than that required for mechanical purposes.

In the discussion a number of the engine builders agreed that certain parts could be standardized, especially the fuel check valves. Harte Cooke, McIntosh & Seymour Corporation, believed that this was a suitable subject for investigation by the Oil and Gas Power Division of the society. C. E. Beck, Busch Sulzer Bros. Diesel Engine Company, felt that anything that would reduce costs and improve quality of small parts was worth investigation. A dissenting voice was uttered by D. O. Barrett, Superior Gas Engine Company, who claimed that his company had found it better to make the parts in the engine factory.

RECENT PUBLICATIONS

THE MOLLIER STEAM TABLES AND DIAGRAMS, EXTENDED TO THE CRITICAL PRESSURE. By Dr. Richard Mollier, professor at the Technical High School, Dresden. English edition adapted and amplified from the third German edition by Dr. H. Moss. Published by Sir Isaac Pitman & Sons, Ltd., London, 1927. Cloth, 5½x9 in.; 26 pages of text, 27 pages of tables, with two inserted charts 18x24 inches.

THE text pages discuss the sources of information and point out that fairly accurate data are available up to 1,500 lb. per sq.in. Beyond this point the data have been extrapolated to the critical point. All published experimental results have been taken into account, as well as the theoretical requirements. The values up to the critical point must be sufficiently near to the true values to be of use until further experiments are completed over the region of highest pressure.

Several pages are devoted to explaining the application of the charts and tables to various engineering problems, and there is a brief discussion on the conversion of units. The table gives temperatures in Centigrade degrees and heat quantities in pound calories per pound of steam. Interpolation formulas are given for securing values intermediate between those tabulated.

The tables present properties tabulated with both temperature and pressure as arguments.

The large Mollier charts included in an envelope in the back of the volume, are identical except that one of them carries constant volume lines printed in red to avoid the confusion that would result if both constant volume and constant pressure lines were printed in the same color.

Owing to the use of Centigrade units, this volume will not be as convenient for American engineers as it might be, but those who are engaged in the design of high-pressure steam equipment will doubtless find it a valuable source of information.

NATIONAL ELECTRICAL SAFETY CODE. Published by the U. S. Government Printing office, Washington, D. C. Cloth; 5x7½ in., 525 pages. Price, $1.

THIS is the fourth edition of the code and was prepared by the Bureau of Standards. The revision of this edition has been carried out under the rules and procedure of the American Engineering Standards Committee. The entire code, as revised, has been approved by this committee. The code is divided into five parts; Rules for the installation and maintenance of electrical supply stations; rules for the installation and maintenance of overhead and underground electrical supply and communication lines; rules for the installation and maintenance of electric utilization equipment; rules for the operation of electrical equipment and lines; rules for radio installations. The most important changes made in this edition are in Parts 2, 4 and 5, dealing with overhead lines and radio. These sections have been for the most part rearranged and new material added. For those interested in the problems of electrical design, construction and operation, this code is a valuable guide.

PRINCIPLES OF MECHANICAL REFRIGERATION, Second Edition. By H. J. Macintire, Associate Professor of Refrigeration, University of Illinois. Published by McGraw-Hill Book Co., Inc., New York City. Cloth; 6x9 in.; 312 pages, 146 illustrations. Price, $3.

USUALLY, second editions are made up of the original printing with the errors corrected and a few pages added to make the edition justified. In the case of this book a considerable amount of new material has been added. Chap. II, dealing with thermo-dynamics, has been completely rewritten. It is rather difficult, however, to find the chapter of value as rewritten, for the volume is intended for the practical engineer and the material is just a little over his head. With this exception the volume is suitable for the man who is trying to learn the refrigeration business and to such it should have a ready acceptance.

SOME REFRACTORIES WHICH ARE IN A DEVELOPMENT STAGE. By G. A. Bole, research professor, Ohio State University. Technological Paper No. 5, published by American Refractories Institute, Oliver Building, Pittsburgh, Pa. 13 pages. Price, 50 cents.

RESEARCH in the field of future refractories has in recent years looked to the development of product to meet given sets of service requirements, rather than to develop products merely for their high refractoriness. The pamphlet discusses some of the materials, such as diaspore, mullite, cyanite, dolomite and chrome-diaspore, with which researches are now being conducted from this new standpoint. It discusses the results of these studies up to December, 1927.

THE ENGINEERING INDEX, 1927. Published by the American Society of Mechanical Engineers, 29 West 39th Street, New York. Cloth; 6x9-in. 898 pages. Price $7.50 for members, and $8.50 for non-members.

IN THIS volume are classified abstracts of engineering subjects that have appeared in over 700 periodicals. With this edition the American Society of Mechanical Engineers brings to a close the present system of Engineering Index and inaugurates the new Engineering Weekly Card Index Service. Through this service weekly annotations may be obtained in card index form of articles published in over 1,700 technical publications.

PROBABILITY, AND ITS ENGINEERING USES. By Thornton C. Fry, Ph.D., member of the Technical Staff, Bell Telephone Laboratories, Inc. Published by D. Van Nostrand Company, Inc., New York, 1928. Cloth; 6x9 in.; 476 pages, with graphs, charts and tables. Price, $7.50.

THIS volume is a clear and sensible discussion of the subject that should prove helpful to research workers whose mathematical equipment enables them to follow the author's straightforward presentation. The subject is naturally involved and demands elaborate mathematical expression if clearness is to be attained. The author has done the job well.

JOINT WIPING AND LEAD WORK. By William Hutton. Third edition. Published by Scientific Book Corporation, New York City. Cloth; 5x7½ in.; 80 pages; 116 illustrations. Price, $1.

EVEN though plumbers are abandoning lead work in favor of factory-made slip joints and fittings, this little volume should be of interest to every plumber. While, as the author states, joint wiping can be learned only through actual practice, the illustrations give an excellent idea of the best methods. It is unfortunate that the author did not cover wiping of joints of lead-covered electrical cables.

ANNUAL REPORT OF THE DOMINION WATER POWER AND RECLAMATION SERVICE—The Dominion Water Power and Reclamation Service of the Department of the Interior of Canada has recently issued the Annual Report of its activities for the fiscal year ending March 31, 1927. The report (82 pages with 11 plates and 3 tables) describes the various administrative responsibilities of this service under four main divisions of activity: International waterway matters, water power, irrigation and drainage. Part I describes the international waterway matters receiving attention during the year. Part II deals with the investigatory and administrative work of the Service with regard to water power, statistics of water-power resources and their use in the leading industries, and the field reports of the district chief engineers including the operations of the Dominion Hydrometric Survey. Part III describes the surveys and inspections made for irrigation, domestic water supply and drainage purposes during the year. Copies of this report will be supplied free of charge on application to the Director of the Dominion Water Power and Reclamation Service, Ottawa, Canada.

NEWS OF THE FIELD

The editors will welcome the co-operation of readers in reporting interesting happenings, personal or otherwise

Chief Boiler Inspectors Meet at Erie for Sixth Annual Convention

Stampings for Repair Drums Recommended; Accidents to Code and Non-Code Boilers Compared; Properties of Alloy Steels for High-pressure Boilers Discussed; and Tests Made to Determine Stresses Around Nozzle Openings Described

THE National Board of Boiler and Pressure Vessel Inspectors, whose membership consists of the chief inspectors of those states and cities that have adopted the A.S.M.E. Boiler Code, met for its Sixth Annual Meeting last week at Erie, Pa. Although comprising essentially a small group of about sixty members and associates, the convention through its program and discussions, reflected its importance as a predominant factor in promoting safer boiler practice throughout the country.

Following addresses by several local officials, Chairman C. W. Thomas opened the meeting on Monday morning with a brief address and was followed by C. O. Myers, secretary-treasurer, who reported the recommendations of the Executive Committee as to the stamping of boilers not completely assembled in the shop and the stamping of repair drums. These were the same as reported the previous week at the convention of the American Boiler Manufacturers' Association (see *Power*, page 1123, June 19 issue).

The Executive Committee also unanimously agreed and so advised the Code Committee that boilers should be stamped upon completion with the year built.

Mr. Myers further pointed out some of the possibilities of the Board and cautioned that these are attainable only through the closest co-operation and trust between state and city officials charged with the administration of boiler inspection laws. The confidence of other interests affected, such as boiler manufacturers, insurance companies, and users of boilers, must be maintained through proper consideration being given to their viewpoints in all cases that come up for decision.

F. C. Peal, Statistician of the Board, offered some illuminating figures comparing accidents among Code boilers and non-Code boilers. According to reports regularly received from the insurance companies, there are 284,378 boilers insured, and a total of 215,952 Code boilers were reported by the chief inspectors. This leaves a difference of 68,426 boilers for non-Code territory, exclusive of boilers that are not insured. Of the 345 accidents reported during the year, the ratio of non-Code boiler accidents to Code boiler accidents was 6 to 1. Of the total number reported, 42 were major accidents (accompanied by fatalities); six of these were Code boilers and 36 non-Code. There were only five failures reported on low-pressure steel boilers and 210 on cast-iron sectional boilers. Furthermore, 90 per cent of the water-tube and horizontal-tubular boiler accidents were tube and blowoff failures.

Charles E. Gorton reviewed the present situation as to probable further adoption of the A.S.M.E. Code and said that bills to this end would be introduced into the legislatures of four more states during the year. Hawaii, he said, although not a Code territory, has 98 per cent of its boilers operating under the Code, owing to its having been adopted by various associations such as the sugar planters and pineapple growers. The situation in Porto Rico is somewhat similar.

At the technical session on Tuesday morning a joint paper by J. B. Romer and W. W. Eaton, both of the Babcock & Wilcox Company, discussed the properties of various alloy steels and their abilities to meet present conditions imposed by higher pressures and temperatures in boiler practice, as well as corrosive resistance. An abstract of this paper will appear later.

Dr. D. S. Jacobus was scheduled to talk on "Dished Heads," but in his absence C. W. Obert reviewed briefly the conditions leading to the recent changes in the A.S.M.E. Boiler Code formula for the strength of such heads.

R. K. Hopkins of the M. W. Kellogg Co. read a paper by H. O. Whitney, which described tests made to ascertain the comparative stresses existing around nozzle openings with and without reinforcement. A 60-in. diameter tank, having $1\frac{1}{4}$-in. wall thickness, with a 14-in. flanged nozzle was employed and strain gage readings were taken at various pressures. The results showed that a 1-in. reinforcing pad, welded to the neck of the nozzle was of material benefit. At 500-lb. per sq.in., the maximum stress for the plain nozzle was 345 per cent of the shell stress, whereas in the reinforced nozzle the maximum stress at this pressure was only 121 per cent of the shell stress. A study of this test indicated that if a pad, of a thickness equal to that of the shell, is properly attached to the nozzle opening, the maximum stress around the nozzle will not exceed the stress existing in the wall of the vessel.

"The Relationship of the Boiler Manufacturer to the National Board of Boiler and Pressure Vessel Inspectors" formed the topic of a brief address by George W. Bach, vice-president of the Union Works. "The manufacturer," he said, "welcomes shop inspection because close co-operation between the shop management and the inspector eliminates trouble in the field." At the same time, he warned against the destructive type of inspection where the inspector sometimes feels it necessary to find fault in order to give the impression that he is "on the job."

Many Plants Visited

An important feature of the program were the inspection trips to local boiler shops and other near-by plants. At the Erie City Iron Works a demonstration of burning powdered coal was given, and some large flanging work was seen at the Union Works. At the plant of the Sims Company welded low-pressure heating boilers were seen under construction. At Orville, Ohio, the delegates had an opportunity to see the largest welded pressure vessel in the world, and at the Reeves Brothers plant in Alliance there was given a demonstration of welding under the procedure control of longitudinal and girth joints of large unfired pressure vessels.

Entertainment features included a boat trip to Canada, a fish fry, and a luncheon as guests of the Erie City Iron Works.

Largest Portable Sub-station Being Built for Railway Use

Designs have been completed and work is being speeded on the world's largest portable railway substation which is being constructed by the Westinghouse Electric & Manufacturing Company for the Paulista Railroad Company, of South America. When completed, this station will be used on the 150-mile electrified line which runs between the towns of Jundiahy and Rancao in the heart of the coffee district of Brazil.

The station will include two cars with a total weight of approximately 150 tons. Its capacity will be 2,000 kw. It will draw alternating current at 88,000 volts from a transmission line

and will supply direct current at 3,000 volts to the trolley wire.

Except when starting up, its huge generators will run without a man in attendance.

Liverpool to Get New Power Station

Liverpool Corporation has decided to construct a large generating station at the River Mersey Docks. It will be one of the principal power stations in the Lancashire area and will play an important part in the scheme of electrical co-ordination for northwest England, now being completed by the British Electricity Commission.

The first section of the project will cost about $8,000,000. All the current generated at this station will be purchased by the Central Electricity Board for use in Lancashire and Cheshire Counties, including Liverpool itself. The station will be connected by the Board with other important generating stations, including those belonging to the Manchester Corporation and the Lancashire Power Company.

The proposed site for the new station is the Clarence Dock, and arrangements are being made to purchase it from the Docks Board. In accordance with the wishes of the Electricity Commissioners, the station will contain in the first section two alternators each of 50,000 kw. The ultimate capacity of the station will be eight alternators making a total capacity of 400,000 kw. The construction of the new station will have very beneficial effects in the important industrial district involved and will give employment to a large number of men.

Plans Changed for Development of Power on Mersey River

The Nova Scotia Power Commission has signed a contract with the Foundation Company, of Montreal, for the complete execution of the entire construction work involved in the delivery of the hydro-electric power required for the operation of the 250-ton newsprint mill to be constructed near Liverpool, N. S., by the Royal Securities Corporation. Owing to difficulties having arisen in obtaining proper speed regulation, the Commission, after careful study, has decided on a complete change in the method and type of development. The initial undertaking in the development of power on the Mersey River calls for the delivery of 105,000,000 kw.-hr. annually at a rate of 20,000 horsepower.

Until recently it had been proposed to develop this electric power in two plants requiring 6,500 ft. and 1,000 ft. respectively of 16-ft. diameter wood stave pipe, but in accordance with the latest plans the development will be entirely without pipe lines and surge tanks and will, it is thought, afford the best operating conditions. The capital cost is now estimated at $3,659,000, which includes all the lands required. As now planned, there will be three separate developments—at Upper Lake Falls, Lower Lake Falls and Big Lake Falls. The Lower Great Brook Falls site will still be available as well as further capacity at "The Guzzle," where the Town of Liverpool plant is situated, these providing for further ultimate development of 6,200 horsepower.

The intake dam of Upper Lake Falls will also act as a storage dam to create a 20-ft. deep reservoir on Lake Rossignol, whose waters will be supplemented by a diversion channel from Big Jordan Lake, which will be raised by damming. It is expected that the three developments will be ready to deliver power by Oct. 1, 1929.

C. E. Corporation Appoints J. Cleary as Sales Manager

The appointment of James Cleary as general sales manager of Combustion Engineering Corporation will be of interest to a great many men in the power-plant field. Mr. Cleary is one of the best-known men in this field, having engaged in engineering and sales work for over twenty-five years.

James Cleary

His early experience was secured with Westinghouse Church Kerr Company as erecting and operating engineer in various parts of the United States. He was sent to England as erecting and operating engineer on the Metropolitan Railway Company's plant, London, the Mersey Railway plant, Liverpool, and the Clyde Valley Electric Power Company's plant, Glasgow.

On returning to this country, he became associated with the Westinghouse Machine Company. In the Spanish-American War, Mr. Cleary served as chief machinist and warrant officer and during the World War was in charge of the steam equipment of the "Old Hickory" government plant.

He has also been connected with various plants in the West and with the Public Service Gas & Electric Company of New Jersey. Since associating himself with Combustion Engineering Corporation, in 1921, he has been district manager of the Philadelphia and Detroit offices and for the last two years assistant general sales manager.

Waldorf Paper Company Installs High-Pressure Boilers

The decision to install boilers to operate at 650-lb. pressure in the new steam plant of the Waldorf Paper Products Company, St. Paul, Minn., is in line with the present tendency in the paper industry to increase operating pressures. This tendency is due to the more efficient operation of turbines at high-pressures, and because it permits bleeding the turbine for steam required in process work at pressure of about 200 lb.

The pressure usually adopted in the paper industry has been between 400 and 450 lb. The Waldorf Paper Products Company, however, after a careful study of all plant operating conditions as well as a survey of their individual requirements found that the use of 650-lb. pressure would be more economical.

Two units are to be installed, each having a heating surface of 11,740 sq. ft. They are of the Edgemoor Multi-unit type.

The new Waldorf plant is now under construction and is expected to be in operation before the end of the year.

Many Hydro-electric Projects Being Considered

The Federal Power Commission has recently taken action on several electric projects of more than usual size. A final license was issued to the Savannah Power Company covering its development on the Savannah River above Augusta, Ga. The company plans to build on this river a plant capable of generating 120,000 hp.

On June 14 the Commission issued a preliminary permit to Hugh L. Cooper for a project in the Z Canyon on the Clark Fork of the Columbia River in Washington. The project includes a dam 390 ft. high, and the initial installation of 300,000 hp. Provisions, however, are to be made for the ultimate installation of 600,000 hp.

Prior to its order of May 28 the Commission had received applications for a number of major hydro-electric projects. Several of these follow:

The Gauley Power Company of Charleston, W. Va. has applied for a license covering the project on the Gauley River in Fayette and Nicholas Counties of West Virginia. The company plans to construct a concrete dam 125 ft. high at a point 21 miles from the mouth of the river. It is estimated 54,500 hp. of primary power will be made available. It proposes to install three 20,000 hp. generators.

The Washington Electric Company of Seattle, Wash., has applied for a preliminary permit covering a project on the Sultan River, Sultan, Wash. The company proposes to build a dam 310 ft. high which will create a reservoir of 230,000 acre ft. capacity. Estimates of the generating capacity of the proposed project have not yet been received.

A preliminary permit has been applied for by L. E. Bryant of Roberta,

Tenn., covering a project on the Rock Castle and the Laurel Rivers near the boundary of Kentucky and Tennessee. It is planned to build a dam 190 ft. high on the Rock Castle River one mile above its mouth, where 20,000,000,000 cu.ft. of water would be stored. The dam on the Laurel River is to be 150 ft. high and would store 7,000,000,000 cu.ft. Power houses are to be below each dam and will be interconnected. Under such a plan it is estimated 28,600 hp. of primary power can be made available and the power is to be used at coal mines in the vicinity.

The Virginia-Carolina Power Co. has applied for a preliminary permit to construct a concrete dam on the Roanoke River, in Brunswick County, Virginia, and Warren County, North Carolina, creating a head of 35 feet and backwater for about 20 miles. The surface area of the reservoir will be about 3,500 acres and the estimated storage about 500,000,000 cu.ft. A steel and concrete power house will be built with a proposed installed capacity of 50,000 horsepower, which will be used for public-utility purposes.

Leipzig Trade Fair Opens August 26

The great Leipzig Fair, the largest Trade Exposition in the world, will be held this fall from Aug. 26 to Sept. 1. The fair will attract buyers from 43 countries, while a score of countries will send some 10,000 exhibits. America's growing activity in world markets is indicated by her sending upward of 2,000 buyers and some fifty exhibits to this great world market place.

The fair is held at the height of the American tourist season and may be conveniently included in a European trip. The exposition, which includes every product of modern industrial life, is so arranged that one can see more in a day at Leipzig than in a month's travel to different markets. A visitor is enabled to review his own trade and its allied branches completely, gaining new ideas, new friends and profitable business contacts.

The Leipzig Fair is approaching its 700th anniversary. Originally a picturesque medieval trading center, it has grown with the times into the most cosmopolitan industrial exchange in the world. Almost one hundred special exposition buildings are used for the displays, forming a town in themselves. From long experience the exhibits are so assembled that visitors can make a close and critical scrutiny of thousands of objects in the shortest possible time. The fair is in every detail a model of efficiency.

America has long recognized the importance of the Leipzig Fair. A century ago American buyers crossed the Atlantic in sailing vessels to attend. Today representative business men from all parts of the United States regularly visit Leipzig, spending millions of dollars in purchases. The possibility of selling American products abroad to widely scattered world markets through the Leipzig Fair has only recently been realized. The exhibits of American machinery and novelties of many kinds are now much in evidence, while a year ago American automobiles completely dominated the international show.

Information concerning the fair may be obtained by addressing the Leipzig Trade Fair, Inc., 11 West 42nd St., New York City.

Order of Steam Engineers Meets at Atlantic City

The forty-second annual convention of the American Order of Steam Engineers was held in Atlantic City, June 11-14. In accordance with the usual custom only delegates and members of the subordinate councils were permitted to attend the business sessions, so no general report of the proceedings is available for publication.

Two general sessions were held each day—morning and afternoon. A joint open meeting of the engineers, exhibitors and visitors was held in the exhibition hall on Monday evening. Short addresses were made by chairman Small, Supreme Chief Thomas Connell and Harry Schuh of the Philadelphia office of Jenkins Bros., president of the American Supply Men's Association.

Following this formal program a vaudeville entertainment was given by professional talent, including several songs sung by Joe McKenna of Jenkins Bros., New York. The ladies' auxiliary held daily sessions at the Jefferson Hotel during the convention.

The American Supply Men's Association held an exhibition of power equipment in conjunction with the convention. About forty manufacturers occupied booths.

The election of officers for the American Order of Steam Engineers for the coming year resulted as follows: Supreme Chief Engineer, D. M. Sullivan, Camden Council No. 3; Supreme First Assistant Engineer, Alphonse Seines, Atlantic City No. 4; Supreme Recording Engineer, George Farney, Union No. 4; Supreme Corresponding Engineer, Wm. S. Wetzler, Philadelphia No. 7; Supreme Treasurer Engineer, John J. Kelly, Philadelphia No. 7; Supreme Senior Master Mechanic, George Landis, Progress No. 13; Supreme Junior Master Mechanic, Thomas Small, Atlantic City No. 4; Supreme Chaplin, Emil Maerky, Camden No. 3; Supreme Inside Sentinel, Pierson A. Hedden, Philadelphia No. 7; Supreme Outside Sentinel, Oscar Kurtz, Germantown No. 22; Supreme Trustee, George W. Richardson, Atlantic City No. 4.

The officers elected by the American Supply Men's Association were: President, Hugh Edwards, Garlock Packing Company; vice-president, Ernest Buchanan, Joseph Dixon Crucible Company; treasurer, Fred L. Jahn, Watson & McDaniel Company; secretary, Robert Martin, Keystone Lubricating Company. Joseph Gassenmeyer of Dearborn Chemical Company was reappointed Director of Exhibits.

Rochester Convention Will Discuss Smoke Prevention

At Rochester on June 26 the Smoke Prevention Association will convene for its twenty-second annual convention. The morning session of June 26 will be devoted to an opening address by the association's president Andrew J. Glascott and addresses of welcome by prominent Rochester officials. In the afternoon T. A. Novotney, sales engineer, National Radiator Corporation, will present a paper on "Requirements for Heating Boilers for Smokeless Combustion" and Homer Linn of the American Radiator Company, Chicago, Ill., will address the convention on the "Relation of Chimneys to Smoke Prevention."

At the Wednesday morning session the relation between "Soft Coal Smoke and Health" will be discussed by Dr. G. W. Goler, Rochester Health Officer; the "Removal of Soot and Cinders From Flue Gases" will be the subject of an address by Louis C. Whiton of the Prat-Daniel Corporation, N. Y., and I. E. Powell of the Rochester Gas and Electric Corporation will present a paper on "Central Heating Plants Using Powdered Fuel in Relation to the Elimination of Smoke." In the afternoon two papers will be presented, one on "Burning Wood Refuse Smokelessly," by Harlan W. Bird, and the other "Abating Smoke in Heating Plants With Stokers," by Joseph A. Harrington, the King Coal Stoker Company, Chicago, Ill.

The entire day of June 28 will be devoted to problems relating to the elimination of smoke from locomotives and railroad yards.

Entertainment will be provided by a theater party Tuesday evening, a luncheon on Wednesday at Station 8 of the Rochester Gas and Electric Corporation, and inspection trips Saturday to the Taylor Instrument Company and Bausch & Lomb Optical Company. The ladies will be entertained Wednesday at a tea and tour of the city by the Women's City Club.

Award Conditions of Miller Medal Revised by A.W.S.

The Board of Trustees of the Samuel Wylie Miller Medal, which was established by S. W. Miller, past-president of the American Welding Society, had no paper submitted to it during the calendar year 1927 of sufficient value to merit the award for that year. The Board has, therefore, revised the conditions under which the medal may be awarded as follows:

"The medal may be awarded annually for any meritorious achievement which, in the judgment of the Board of Trustees, has contributed conspicuously to the advancement of the art of gas fusion welding and cutting or the art of electric arc fusion welding and cutting.

"The award for any calendar year shall be announced and the medal, together with a suitable certificate, presented at an Annual meeting or a Fall

meeting of the Society as the Board of Trustees may elect."

The conditions governing the award of this medal have been made very broad so that it can be granted for an achievement of any character that has contributed conspicuously to the advancement of either of the two branches of the welding art that are specifically mentioned.

Business Notes

Power Plant Equipment Company, of Kansas City, Mo., has removed to larger quarters because of the increasing demand for Marley equipment. The new address is 1737 Walnut St.

The Ames Pump Company, Inc., 90 West St., New York City, announces the appointment of the following sales representatives: The Simonds Machinery Company, 520 East 4th St., Los Angeles, Calif., and 816 Folsom St., San Francisco, Calif., also the Pump & Equipment Company, 16 Water St., Norwich, Conn., and 945 Main St., Bridgeport, Conn.

The C. O. Bartlett & Snow Company, of Cleveland, announces the opening of a Chicago office at 505 First National Bank Building, with S. G. Artingstall, Jr., as manager.

A. B. Benson, formerly secretary and treasurer of the Conveyors' Corporation of America, has been appointed general manager of the Joseph Harrington Company, a subsidiary of Whiting Corporation, Harvey, Illinois.

Charles H. Upson, who for the last 23 years was district manager for the Dodge Manufacturing Company, has joined the sales organization of the Chain Belt Company. With headquarters at Cincinnati he will represent the company's complete line of Rex Chain and Transmission Machinery.

Welding Exposition Featured at A.W.S. Fall Meeting

The 1928 Fall Meeting of the American Welding Society in Philadelphia, Oct. 8 to 12, promises to set a new record for successful accomplishments. As in the last few years, one of the outstanding features will be the exposition. The exhibit is held in co-operation with the American Society for Steel Treating.

The days during the exposition are now known as National Metal Week. Therefore, nation-wide attention will be focused on this convention.

The exhibit will occupy all the floor space of the Exhibition Hall of the Commercial Museum. Five days will be devoted to displaying to the industrial world the best in welding equipment and supplies, and exhibits of welded products will be an attractive addition.

Technical meetings and registration will be held at the Bellevue-Stratford Hotel in the morning and at the Exhibition Hall in the afternoon of each day. The Meetings and Papers Committee is preparing an unusually strong program of interesting papers containing new information and findings.

During this convention period thousands of men representing the American Welding Society, the American Society for Steel Treating and the Institute of Metals Division of the Mining and Metallurgical Engineers will be gathered together.

Coming Conventions

American Institute of Electrical Engineers, annual Summer convention at Denver, Colo., June 25-29; F. L. Hutchinson, secretary, 33 West 39th St., New York City.

American Society of Heating and Ventilating Engineers, Summer meeting at West Baden Springs Hotel, West Baden, Ind., June 26-29; A. V. Hutchinson, secretary, 29 West 39th St., New York City.

American Society of Mechanical Engineers, Twin-City regional meeting at St. Paul, Aug. 27-30; Boston regional meeting, Oct. 1-3; second national fuels meeting at Cleveland, Ohio, Sept. 17-20; Calvin Rice, secretary, 29 West 39th St., New York City.

American Society for Testing Materials, Atlantic City, June 25-29.

Association of Iron and Steel Electrical Engineers, annual convention and Iron and Steel Exposition at Hotel Stevens, Chicago, June 25-29.

Canadian Steel and Power Show at the University of Toronto Arena, Sept. 4-7; Campbell Bradshaw, secretary, 24 Front St., West Toronto, Canada.

National Association of Power Engineers, annual convention at Detroit, Sept. 11-15, and concurrently National Exhibitors' Assn. exhibit; Fred Raven, 417 South Dearborn St., Chicago.

National Association Practical Refrigerating Engineers, annual convention at Louisville, Kentucky, Nov. 20-23; E. H. Fox, secretary, 5707 West Lake St., Chicago, Ill.

Stoker Manufacturers Association, fall meeting at Greenbrier Hotel, White Sulphur Springs, W. Va., Oct. 22-24.

Second Bituminous Coal Conference will be held at Pittsburgh, Nov. 19-22.

Universal Craftsmen Council of Engineers, Newark, N. J., Aug. 7-10.

World Power Fuel Conference at the Imperial Institute, London, Sept. 24 to Oct. 6.

Personals

John W. Myer, of Philadelphia, was elected president of the National District Heating Association at the annual convention held in Atlantic City, June 12 to 15.

Vreeland Tompkins, president of the Smooth-On Manufacturing Company, was awarded the honorary degree of Master of Science at the commencement exercises of Rutgers University. The degree was conferred for distinguished accomplishments as a chemist and inventor.

G. H. Spencer, formerly with S K F Industries, Inc., New York, has become associated with the Minton Vacuum Dryer Corporation, Greenwich, Conn.

E. N. Baldwin, formerly with Westinghouse Electric & Manufacturing Company, Sharon, Pa., is now in the Engineering Department of the Kaestner & Hecht Company, Chicago, Ill.

Perry R. Cassidy, who for a number of years has been associated with the Babcock & Wilcox Company, has recently been elected vice-president of the Fuller-Lehigh Company.

Arthur Graham Glasgow, of London, England, an authority on water-gas manufacture, delivered the address to the graduating class of Stevens Institute of Technology last week, and received the advanced degree of Doctor of Engineering from the institution, which is his alma mater. Mr. Glasgow,

Fuel Prices

COAL

The following table shows the trend of the spot steam market in various coals, f.o.b. mines; mine run, except Pittsburgh gas slack:

Bituminous (Net Tons)	Market Quoting	Price per Ton
Navy Standard	New York	$2.40@$2.60
Kanawha	Columbus	1.25@1.60
Smokeless	Cincinnati	1.75@2.25
Smokeless	Chicago	1.65@2.00
S. E. Kentucky	Chicago	1.25@1.50
Steam	Pittsburgh	1.40@1.80
Gas Slack	Pittsburgh	1.10@1.25
Big Seam	Birmingham	1.40@1.75
Anthracite (Gross Tons)		
Buckwheat	New York	$2.75@$3.00
Birdseye	New York	1.60

FUEL OIL

New York—June 21, f.o.b. Bayonne, N. J.: 28@34 deg., Baumé, industrial use, tank-car lots, 4⅜c. per gal.; 36@40 deg., furnace, tank-car lots, 7c. per gal.

St. Louis—June 11, tank-car lots, f.o.b. St. Louis, 24@26 deg., $1.45 per bbl.; 26@28 deg., $1.50 per bbl.; 28@30 deg., $1.55 per bbl.; 30@32 deg., $1.60 per bbl.; 32@36 deg. gas oil, 4.3c. per gal.; 38@40 deg., 5c. per gal.

Pittsburgh—June 11, f.o.b. local refinery, 30@34 deg., fuel oil, 5¼c. per gal.; 36@40 deg., 5½c. per gal.

Philadelphia—June 13, 26@30 deg., $2.07 per bbl.; 13@19 deg., $1.22 per bbl.; 22 plus, $1.48@$1.55 per bbl.; 27@30 deg., $2.17 per bbl.

Cincinnati—June 11, tank-car lots, f.o.b. local refinery, 24@26 deg. Baumé, 5c. per gal.; 26@30 deg., 5¼c. per gal.; 30@32 deg., 5.95c. per gal.

Chicago—June 16, tank-car lots, f.o.b. Oklahoma, freight to Chicago, 90c. per bbl.; 22@26 deg., 80c. per bbl.; 26@30 deg., 85c. per bbl.; 30@32 deg., $1.02½@$1.05 per bbl.

Boston—June 19, tank-car lots, f.o.b. 12@14 deg. Baumé, 5.65c. per gal.; 28@32 deg., 4.35c. per gal.

Dallas—June 16, f.o.b. local refinery, 26@30 deg., $1.30 per bbl.

who is a native of Buchanan, Va., was graduated from Stevens in the class of 1885. He was recently awarded the Walton Clark medal by the Franklin Institute of the State of Pennsylvania for the Promotion of the Mechanic Arts, in recognition of "outstanding and valuable work in the technology and development of the manufactured gas industry."

F. H. ROSENCRANTS, Director of Engineering, International Combustion Engineering, Ltd., was awarded the Kelvin Gold Medal of Merit by the Institution of Electrical Engineers of England, in recognition of his work in the combustion field.

H. S. BEAN, of the Gas Measuring Instrument Section of the Bureau of Standards, will take charge of the cooperative investigation in Buffalo of the Bureau of Standards, the Bureau of Mines and the Natural Gas Department of the American Gas Association, on methods of measuring large volumes of gas.

NICHOLAS STAHL has left the Narragansett Electric Light Company, where he was superintendent of generation, to become manager of engineering and construction, with the Pennsylvania Power & Light Company.

TRADE CATALOGS

UNIT COAL PULVERIZER — The Lopulco unit system for burning pulverized coal is clearly illustrated and described in catalog U-3, just issued by the Combustion Engineering Corporation, 200 Madison Ave., New York City. This mill, which is of the swing-hammer type, is made in a number of sizes with direct or independently driven feeders. Lopulco natural-and forced-draft burners for vertical firing and the couch-type burner for horizontal firing are also illustrated and described.

VENTILATED FURNACE FLOORS—Air-cooled furnace floors and perforated air-cooled furnace wall blocks are described in bulletin B-56, just issued by the Bernitz Furnace Appliance Company, 80 Federal St., Boston, Mass. Plans and elevations of typical floors and walls as well as detail views of the various blocks used in their construction are shown and dimensions given.

OIL BURNERS—B. P. Lientz & Company, 3409 E. 18th St., Kansas City, Mo., has just issued Bulletin No. 428, describing its complete line of oil burners of the steam or air atomization type for practically all types of boilers, stills, and industrial furnaces. The bulletin also describes the Lientz single and multiple gas burners in the plain and refractory types.

OVERHEAD HANDLING DEVICES — Cleveland Crane & Engineering Company, Wickliffe, Ohio, has published a new pictorial bulletin showing applications of the "Cleveland Electric Tramrail" to overhead material-handling.

TRIPLEDUTY VALVE—In bulletin S-8 issued by the Elliott Company, Jeannette, Pa., the use, operation and construction of double-automatic triple-duty valves are described, dimensions and specifications are also given.

CONVEYING, ELEVATING AND CHAIN TRANSMISSION—Link-Belt Company, of Chicago, Indianapolis and Philadelphia. If the amount of usable information put into a general catalog is any criterion of its worth, then the new Link-Belt general catalog 500 is a good example of what an informative general catalog should be. It contains 1,088 pages and not only covers in engineering data and list prices the complete chain, sprocket, power transmission, elevating and conveying and engineering divisions of the company's business, but contains considerable other data for which the engineer has use.

NEW PLANT CONSTRUCTION

Compiled by the McGraw-Hill Business News Department, which is prepared to furnish a more complete daily service to those who wish it

Ala., Alabama City—City voted $70,000 bonds for the construction of a waterworks pumping station.

Calif., Los Angeles—Los Angeles County will receive bids until July 2 for the construction of a 13 story hospital including steam heating, ventilation and refrigeration systems, swimming pools, etc. Estimated cost $4,500,000. E. Bergstrom, M. Hunt, P. Davis, S. P. Hunt and W. Richards, Chamber of Commerce Bldg., are architects.

Calif., Los Angeles—B. Rosenberg, c/o W. D. Lee, Textile Center Bldg., Archt., is having plans prepared for a 12 story apartment building at Rossmore and Rosewood Aves. Estimated cost $650,000.

Calif., San Francisco—W. B. Born, c/o A. Brown, Jr., 251 Kearny St., Archt., plans the construction of a 25 story office and stores building at Pine and Market Sts. Estimated cost $2,000,000.

Ga., Barnesville—City, E. L. Coleman, Mayor, will receive bids until July 9 for waterworks improvements including 500,000 gal. filtration plant, raw water pumping station, etc. Wiedeman & Singleton, 1404 Candler Bldg., Atlanta, are engineers.

Ill., Chicago — Apparel Manufacturers Mart Building Corp., A. R. Clas, Secy. and Treas., c/o W. W. Ahlschlager, 65 East Huron St., awarded contract for a 75 story apparel mart at Wacker Dr. and Michigan Ave. to Starrett Building Co., 8 South Dearborn St. Estimated cost $45,000,000.

Ill., Chicago—W. L. Hoffman, 718 West 63rd St., Archt., is receiving bids for a 7 story apartment building including central refrigeration plant, elevators, etc. at 1608 Sherwin Ave. for N. L. Randall, 7702 East Lake Terrace. Estimated cost $500,000.

Ill., Chicago—Huguelet Bros., 908 Huguelet Pl., are having plans prepared for an 18 story apartment building at 63-67 East Walton Pl. Estimated cost $1,500,000. Schmidt, Garden & Erickson, 104 South Michigan Ave., are architects.

Ill., Chicago — Koenigsburg & Weisfeld, 155 North Clark St., Archts., will soon receive bids for an 8 story apartment and stores building at Bryn Mawr and Winthrop Aves. for M. Malter, 1060 Balmoral Ave. Estimated cost $800,000.

Ill., Chicago — Leichenko & Esser, 38 South Dearborn St., Archts., will receive bids until June 28 for a 7 story apartment building including mechanical refrigeration system, elevators, etc. at 5609 Washington Blvd. for Syndicate, c/o architects. Estimated cost $700,000.

Ill., Chicago—John R. Thompson Co., 350 North Clark St., is having sketches made for a 23 story office and stores building including ventilation system, etc. at 23-29 West Randolph St. Estimated cost $3,000,000. A. S. Alschuler, Inc., 28 East Jackson Blvd., is architect.

Ill., Collinsville—City is having plans prepared for the construction of a sewage disposal plant including pumping station, etc. Estimated cost $250,000. Kinsey Engineering Co., Marshall Block, Pekin, is engineer.

Ill., Lyons—City will soon receive bids for the construction of a waterworks pumping station. Estimated cost $30,000. Kelker, DeLeuw Co., 111 West Washington St., Chicago, is engineer.

Ky., Louisville—John N. Norton Memorial Infirmary, awarded contract for the construction of a heating and laundry building. Estimated cost $50,000.

Ky., Louisville — U. S. Engineer Office, will receive bids until July 9, for the construction of a pump house, pump pit, etc. at Lock and Dam 51 on Ohio River.

Md., Baltimore—Taylor & Fisher, Union Trust Bldg., and Smith & May, Calvert Bldg., Archts., will receive bids until July 2 for a 32 story bank and office building including steam heating and refrigeration systems, elevators, etc. at Light and Baltimore Sts., for Baltimore Trust Co., D. Symington, Pres., 25 East Baltimore St. Estimated cost $3,000,000. H. F. Doelman, 516 North Charles St., is engineer.

Mass., Boston—North Station Industrial Building Inc., Boston, Mass., c/o S. Scott Joy, 180 North Michigan Ave., Chicago, Ill. Archt., awarded contract for a 13 story loft and office building here to Turner Construction Co., 178 Tremont St., Boston, Mass.

Mass., Chelsea (Boston P. O.)—Ice Utilities Corp., c/o Funk & Wilcox, 26 Pemberton Sq., Boston, Archts., is receiving bids for the construction of an ice plant at Third, Maple and Summer Sts.

Mass., Lynn—City, H. S. Gruver, Supt. of Schools, will soon award contract for addition to Western Junior high school including boiler house, coal pocket, etc. on Hood St. Estimated cost $150,000. Private plans.

Mass., Maynard—Sewage Commission, will soon award contract for the construction of a sewage disposal plant and pumping station. F. A. Barbour, 73 Tremont St., Boston, is engineer.

Mass., Salem—Owner, c/o York Ice Machinery Corp., 200 Causeway, Boston, Engr., is receiving bids for the construction of an ice plant on Franklin St. Estimated cost $100,000.

Mich., Detroit—Griswold Bldg. Co., 1313 Dime Bank Bldg., awarded contract for a 12 story office building on Griswold St. to Otto Misch Co., 159 East Columbia St. Estimated cost $750,000. Steam heating and ventilation systems, boilers, elevators, etc. will be installed.

Mich., Detroit—A. G. Wilson, c/o Smith, Hinchman & Grylls, 800 Marquette Bldg., Archts., is having plans prepared for a theatre including steam heating and ventilation systems, boilers, etc. on Madison Ave. Estimated cost $2,500,000.

Mich., Port Huron — Huron-St. Clair Hotel Co., c/o R. Kemp, Huron Ave., is having plans prepared for a 7 story hotel including steam heating system, boilers, elevators, etc. Estimated cost $850,000. Architect not announced.

Minn., Minneapolis—R. R. Rand, Jr., 914 Roanoke Bldg., awarded contract for a 22 story office building at 6th St. and Marquette Ave. to C. F. Haglin & Sons, 920 National Bldg. Estimated cost $1,500,000. Steam heating system, etc. will be installed.

Minn., St. Paul — Minnesota Conference Augustana Syndicate, c/o L. B. Benson, Supt., Bethesda Hospital, 1060 Laurel Ave., plans the construction of a 5 story hospital including steam heating system, etc. at Capitol and Como Aves. Estimated cost $500,000. Architect not announced.

Miss., Columbia—Mississippi Industrial & Training School, is having preliminary plans prepared for a training school including power plant, etc. Estimated cost $175,000. V. B. Smith, Jr., Gulfport, is architect.

Miss., Greenville—City is having plans prepared for the construction of a power plant. Burns & McDonnell Engineering Co., 400 Interstate Bldg., Kansas City, Mo., are engineers.

Miss., Oxford—University of Mississippi, is having preliminary plans prepared for the construction of a university including extension of power plant, etc. Estimated total cost $1,590,000. F. P. Gates Co., Edwards Hotel, Jackson, is architect.

N. J., Bloomfield—Bd. of Commissioners, Essex Bldg., awarded contract for the construction of a boiler house on Franklin St. to D. J. Cronin, 73 South Orange Ave., Newark. Estimated cost $40,000.

N. J., Rahway—Rahway Memorial Hospital, F. W. Kidd, Pres., 181 Jacques Ave., awarded contract for the construction of a hospital at Stone and Jefferson Sts. to John Lowry, 270 Madison Ave., New York, N. Y. Estimated cost $500,000. Steam heating, ventilation and refrigeration systems, etc. will be installed.

N. J., Wanaque—North Jersey Dist. Water Supply Comn., 24 Commerce St., Newark, plans the construction of a pumping station, here. Estimated cost $300,000. G. W. Fuller, 24 Commerce St., Newark, is engineer.

N. Y., New York—New York Edison Co., Irving Pl., had plans prepared for extensions and improvements to sub-station at 123 East 83rd St. Estimated cost $200,000.

N. Y., New York — One Hundred Sixty West Seventy Third St. Corp., J. T. Brady, Pres., 263 West 38th St., will soon award contract for the construction of an apartment building at 158 West 3rd St. Estimated cost $1,000,000. Tillion & Tillion, 415 Lexington Ave., are architects.

O., Cleveland—Jewish Orphans Home, c/o E. Joseph, 705 Union Trust Bldg., awarded contract for the construction of a group of buildings including 74 x 77 ft. power plant, etc., on North Woodland Rd., to A. A. Lane Construction Co., 1869 East 55th St. Estimated cost $2,000,000.

O., Elyria—J. C. Thompson, c/o Farnam & Lawrence, 977 The Arcade, Cleveland, Archts., is having preliminary plans prepared for a 10 story hotel, bank and theatre building including steam heating system, elevators, etc. Estimated cost $1,000,000.

O., Ohio—Dept. of Welfare, J. E. Harper, Dir., Ninth and Oak Sts., Columbus, will receive bids until July 11 for the construction of a 98 x 105 ft. power house on West Broad St., here. Estimated cost $70,000.

Pa., Philadelphia — H. H. Kline, 709 Chestnut St., Archt., is preparing plans for an 8 story apartment building at 48th and Locust Sts. Estimated cost $1,000,000. Owner's name withheld.

Pa., Pittsburgh—The Development Co., Webster Hall, is having plans prepared for an 8 story apartment building including steam heating and refrigeration systems, boilers, elevators, etc. Estimated cost $750,000. C. N. Agree, 1140 Book Tower, Detroit, Mich., is architect.

S. C., Greenville—Myrtle Beach Estates Inc., awarded contract for a 10 story hotel including cold storage plant, etc. to Consolidated Engineering Co., 20 East Franklin St., Baltimore, Md. Estimated cost $1,000,000.

Tex., Beaumont—E. G. Edson, c/o Edson Realty Co. awarded contract for a 19 story hotel at Pearl and Liberty Sts. to Christy-Dolph Construction Co., Const-Ind Bldg., Dallas. Estimated cost $1,500,000.

Tex., Dallas—City will soon receive bids for the construction of a water purification plant, pumping station, reservoir, etc. E. A. Woods, is city engineer.

Tex., Fort Worth—C. A. O'Keefe, 520 South Summit St., will soon receive bids for an 18 story hotel at 5th and Main Sts. Estimated cost $700,000. Mauran, Russell & Crowell, 1620 Chemical Bldg., St. Louis, Mo., are architects.

Tex., Galveston—American National Insurance Co., c/o S. Moody, American National Insurance Co., V. Pres., is having plans prepared for a 14 story office building including steam heating system, etc. at Mechanic and Twenty-First Sts. A. Fraser, 624 American National Insurance Bldg., is architect.

Tex., Plainview—Community Power & Light Co., Planters Bldg., St. Louis, Mo., and Texas Utilities Co., Plainview, plan the construction of a super power plant here. Private plans.

Wash., Seattle — H. Hudson, American Bank Bldg., plans the construction of an 11 story hotel at 8th and Spring Sts. Estimated cost $750,000.

Wash., Seattle—G. J. Swinn, Inc., Hoge Bldg., plans the construction of a 14 story hotel at 5th and Virginia Sts. Estimated cost $1,000,000. Owner is general contractor.

Ont., Ottawa — Ottawa Hydro-Electric Commission, 109 Bank St., plans the construction of a distribution station on Carling Ave. Estimated cost $50,000.

Ont., Peterboro—Hospital Board, plans extension to present hospital building including heating and refrigeration plant. Estimated cost $350,000.

Que., Sorel—Shawinigan Water & Power Co. Ltd., 83 Craig St. W., Montreal, will soon award contract for a hydro-electric development on the St. Maurice River.

Chile — Electro-Siderurgical de Valdivia, Valparaiso, awarded contract for the construction of a 30,000 hp. power plant on Valdivia Lake in Andes Mts., also rebuilding plant for electric smelting at Port Corral, 100,000 ton annual capacity to J. G. White Engineering Corp., 43 Exchange Pl., New York, N. Y. Estimated cost $6,000,000. Ore to be supplied from Bethlehem mines at Tofo.

Equipment Wanted

Boiler—Bd. of Chosen Freeholders, Court House, Jersey City, N. J., will receive bids until June 28 for the installation of a new boiler and removal of two old boilers in County Hospital.

Boilers and Generating Equipment—The Toronto Terminals Railway Co., New Union Station, Toronto, Ont., plans the installation of boilers and electrical generating equipment (later) for proposed central power plant.

Boilers, Pumps, Generating Units, etc.—Dept. of Welfare, J. E. Harper, Dir., Ninth and Oak Sts., Columbus, O., is in the market for two 270 hp. boilers, three circulating pumps and two 125 kva. generating units for proposed power house at Cleveland, O. Estimated total cost $85,000.

Electrical Equipment — State Highway Dept., Jackson, Miss., will receive bids until July 12, for machinery, electrical equipment, etc. in connection with proposed bridge at Gulfport, Miss.

Engine, Generator, Switchboard, etc.—City of Kennett, City of Kennett, Mo., D. Stroud, Clk., will receive bids until July 17 for one 120 hp. Diesel oil engine unit, direct connected to 80 kw. generator with exciter; two 240 hp. Diesel oil engine units direct connected to a 160 kw. generator with exciters, switchboard, etc., for proposed power plant.

Pumping Equipment—City of Alice, Tex., plans to purchase pumping equipment, etc. for proposed waterworks improvements.

Pumping Equipment—City of Lewisville, Ark., plans to purchase pumping equipment, etc., for proposed waterworks improvements. Estimated cost $70,000.

Pumping Equipment — City of Chelsea, Okla., plans to purchase pumping equipment, etc., for proposed waterworks improvements. Estimated cost $175,000.

Pumps, etc.—City of Ottawa, Ont., plans to purchase pumps, etc., for proposed waterworks improvements. Estimated cost $1,175,000.

Refrigeration Equipment — Bureau of Yards & Docks, Washington, D. C., will receive bids until July 5 for automatic refrigeration equipment for existing refrigerator at Navy Yard, Portsmouth, N. H.

Industrial Projects

Calif., Los Angeles—GLASS FACTORY—Southern California Glass Co., 625 East 9th St., plans the construction of a factory and office at 945 Birch St. Estimated cost $40,000. C. A. Eliot, 328 Union Insurance Bldg., is architect.

Conn., Hartford—TYPEWRITER FACTORY ADDITION—Royal Typewriter Co., 150 New Park Ave., will soon award contract for a 5 story, 70 x 190 and 70 x 70 ft. addition to factory on New Park Ave. Estimated cost $300,000. Greenwood & Noerr, 847 Main St., are architects.

Ia., Marshalltown — AUTO HEATER FACTORY — Cooper Mfg. Co. is having plans prepared for a 2 story, 50 x 150 ft. factory. Estimated cost $50,000.

La., Shreveport—PACKING PLANT ADDITION — Shreveport Packing Co., 725 Texas St., awarded contract for a 2 story addition to packing plant on Mansfield Rd. to Werner Co. Inc., Commercial Bank Bldg. Estimated cost $50,000.

Mass., Attleboro—JEWELRY FACTORY—L. G. Balfour Co., County St., will build a 3 story, 40 x 350 ft. factory and 40 x 60 ft. power plant. Estimated cost $200,000. O. M. Higgins, Park St., is architect. Work will be done by separate contracts.

Mass., Baldwinsville—PAPER MILL—A. L. Adams Paper Co., is having plans prepared for the construction of a 2 story, 80 x 100 ft. paper mill. L. Shlick, 314 Beacon St., Boston, is engineer.

Mass., Watertown (Boston P.O.)—RUBBER FACTORY — Hartz-Mason Rubber Mfg. Co., 270 Pleasant St., awarded contract for a 1 story, 80 x 150 ft. factory to P. T. McMahon, 1081 Washington St., West Newton. Estimated cost $40,000.

Mich., Detroit—TRAILER FACTORY—Fruehoff Trailer Co., 10940 Harper Ave., will soon award contract for a 1 story, 100 x 160 ft. trailer factory on Harper Ave. Estimated cost $50,000. H. P. Stihler, 2931 Gray Ave., is architect.

Mich., Saginaw — FOUNDRY—Chevrolet Motor Co., General Motors Bldg., Detroit, will soon award contract for the construction of a group of buildings for foundry on Washington St. here. Estimated cost $2,000,000. A. Kahn, 1000 Marquette Bldg., Detroit, is architect.

Mo., St. Joseph — GRAIN STORAGE BUILDING, ETC.—Quaker Oats Co., 80 East Jackson Blvd., Chicago, Ill., awarded contract for a grain storage building and three manufacturing units here to Leonard Construction Co., 37 South Wabash Ave. Chicago, Ill. Estimated cost $2,000,000.

N. J., Bayonne—BOLT PLANT—Bayonne Bolt Corp., Trash Ave. and Second St. will build a 1 story, 50 x 287 ft. plant on West First St. Estimated cost $40,000. Private plans. Work will be done by separate contracts.

N. J., Maurer—TILE FACTORY—The American Encaustic Tiling Co., 16 East 41st St., New York, N. Y., awarded contract for a 1 and 2 story, 90 x 640 ft. factory on Tyrett Lane here to The Austin Co., 120 Broadway, New York, N. Y. Estimated cost $125,000.

N. J., New Brunswick — COCOA FACTORY — Reichardt Cocoa & Chocolate Co., Jersey Ave., will soon award contract for a 3 story, 60 x 200 ft. factory. Estimated cost $100,000. R. G. Cory, 30 Church St., New York, N. Y., is architect and engineer.

N. Y., Mariner's Harbor (Staten Island P. O.)—OIL REFINERY—Gulf Refining Co., 21 State St., New York, subsidiary of Gulf Oil Corp., has acuired a tract of 600 acres here and plans the construction of an oil refinery. Estimated cost $20,000,000.

Tex., Pecos—REFINERY—Burford Oil Co., c/o J. J. Thomas, awarded contract for the construction of a refinery, 5000 bbl. capacity to Graver Corp., 409 Todd Ave., East Chicago, Ind. Estimated cost $650,000.

Tex., San Antonio — CANDY and CRACKER FACTORY — Brown Candy & Cracker Co., 810 South Medina St., will soon receive bids for the construction of a factory at El Paso and Medina Sts. Estimated cost $350,000. Private plans.

Sask., Regina — AUTOMOBILE FACTORY — General Motors Co. of Canada, Oshawa, Ont., is having plans prepared for an automobile factory including 400 x 800 ft. assembly building, 50 x 200 ft. office and 80 x 80 ft. power house, etc., here. Estimated cost $1,000,000. Hutton & Souter, 6 James St. S., Hamilton, Ont., are architects.

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Editor
FRED R. LOW
Associate Editors
C. H. BERRY
A. D. BLAKE
Managing Editor
P. W. SWAIN
Business Manager
IRVING FELLNER

POWER

With Which Are Consolidated
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Editorial Staff
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F. A. ANNETT
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MODERN VALVES
For Turbine Service
GOLDEN-ANDERSON

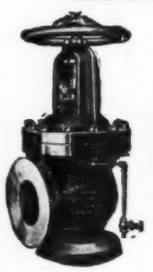
Automatic Cushioned Unloading Valves for Turbine Extraction Lines

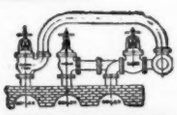
These valves are specially designed for turbine extraction lines. They will positively maintain any desired back pressure, is easily and quickly adjusted to any service condition. May be closed tight with hand wheel any time, locked in automatic position, or set so valve will open but partially.

Furnished for either low or high pressures.
Sizes 2½ inch to 24 inch.

Heaviest Valves Made

The Large Iron and Steel Corps. Order "4575"





Golden-Anderson Life and Property Insurance Valves

1. Prevent expensive shut-downs due to reversal of steam flow.
2. Instantly close and isolate a boiler when a tube ruptures.
3. Simultaneously shut off the steam flow from all boilers when a pipe bursts.
4. Automatically cut a boiler into the line.
5. Prevent back flow of steam into a cold boiler.
6. Positive fool-proof. No springs or adjustments to be made.
7. Can be tested in service.
8. Double Corliss dash pot that cushions in opening and closing.
9. Cannot spin, stick or chatter.

DOUBLE EXTRA HEAVY VALVES "Every Valve sold with a Positive Guarantee."

"No Shut-down when Boiler Tube Bursts"

GOLDEN-ANDERSON
Pat. Automatic Cushioned Water Float Valves

1. Automatically maintain uniform water levels in tanks, standpipes, etc.
2. Instantly adjusted to operate quickly or slowly.
3. Floats swivel to any angle—Most satisfactory float valves known.
4. No Metal-to-metal seats —No water hammer or shock.
5. Cushioned by water and air.
6. ½ to 24 in.

GOLDEN-ANDERSON
Pat. Cushioned Automatic Controlling Altitude Valves

No Freezing in Winter

1. Automatically Maintain Uniform Water Levels in Tanks, Standpipes, Reservoirs, etc.
2. For High or Low pressure. Always Dependable.
3. No Floats or Fixtures used.
4. No Water Hammer or Shocks.

GOLDEN-ANDERSON
Pat. Automatic Cushioned Steam Pressure Reducing Valves

1. Maintain a constant reduced pressure.
2. Thoroughly cushioned.
3. No hammering, chattering or sticking.
4. No auxiliary valves or small by-passes to clog up.
5. No wire drawing.
6. Only one adjustment from the outside.
7. Double extra heavy throughout — practically indestructible.

GOLDEN-ANDERSON
Pat. Automatic Cushioned Water Pressure Regulating Valves

1. Maintain a constant reduced pressure regardless of fluctuations on high pressure side.
2. Perfectly Cushioned by water and air. No metal-to-metal seats.
3. The best valve made for maintaining a constant low pressure where consumption is continuous.
4. Operates quickly or slowly as required—No attention necessary.
5. Positively no hammering or sticking. Sizes to 24 in.

GOLDEN-ANDERSON
Pat. Automatic Cushioned Controlling Float Valve

1. Automatically maintains uniform level in heaters, tanks, etc.
2. Air and water cushioned.
3. No metal-to-metal seats.
4. No waste of water.
5. No water hammer or shock.
6. Angle or Globe patterns to 24 in.

Golden-Anderson Valve Specialty Co., 1317 Fulton Bldg., Pittsburgh, Pa.

The Blue Book of Connery Construction

THE problem of buckling, warping and collapsing in smoke flues, boiler breechings and air ducts has been solved for many firms in the forefront of American industry by the **four newest developments in Connery Construction.**

Connery's Improved Expansion Stiffener

"V" shaped projections pressed into the sheets while cold, utilizing the bellows principle to provide for contraction and expansion. Electrically welded, air and moisture tight construction eliminates buckling, warping and internal corrosion.

Connery's Improved Stack Connection

A rigid electrically welded steel form using the "V" shaped expansion stiffener, provides for connection of stack to breeching and for vertical and horizontal expansion. No other prepared forms are needed while building concrete or brick stacks. When grouted in the stack it forms a seal eliminating leakage at the stack opening.

Connery's Air Cooled Damper

Insures a continuous flow of cool air thus reducing the possibility of warping.

Connery's Adjustable Covering Attachment

For securing the asbestos at any distance from the breeching. These clips are readily applied during assembly.

A Connery bid on your next job will prove to you that Connery Construction *costs no more* than regular construction. Our engineers will be glad to talk it over with you.

CONNERY & COMPANY, INC.
Second and Luzerne Sts., Philadelphia, Pa.
Branch Office: New York

Gold Medal awarded to Connery & Company at the Philadelphia Sesqui-Centennial "For Improved Expansion Compensating and Stiffened draft flues and dampers."

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Pick your packings for permanence

How long a joint stays packed depends on what material you pick to do the work—upon whether you take into consideration the type of service and the fluid handled in the line where the joint is made.

Among the brands of Jenkins Packings are leak-stopping materials that fit your varied needs. If you will let the type of service decide for you where to use each of these four packings, you can be assured that when you pack a joint you make a permanent job of it.

Jenkins Packings are, like Jenkins Valves, made for the maximum service not merely the average. Typical Jenkins care goes into packing manufacture; the material used is the finest, the compounding being done with great skill by experienced workers.

These Packings are obtainable in rolls, sheets, or cut gaskets. It will pay you to use our Ready-Cut Gasket service, if your requirements call for many gaskets of the same size and shape.

Let us send you our packing and gasket folder to keep on hand as a ready reference.

JENKINS BROS.

80 White Street, New York, N. Y. 133 North Seventh Street, Philadelphia, Pa.
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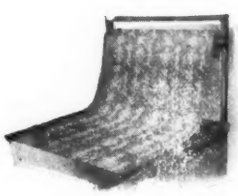
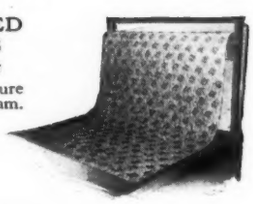
Which
will best serve your needs?

ENARCO
A red packing for hot or cold water and saturated steam at all pressures.



JENKINS '96
A black packing for hot or cold water and saturated steam at all pressures.

COMPRESSED ASBESTOS JOINTING
For high pressure superheated steam.



OILTITE
—as its name implies
—for oil service.

JENARCO 96 JENKINS 96 JENKINS 96 JENKINS 96 JENKINS 96 JENKINS 96

Jenkins Packing

If in doubt consult this folder

The NEW Combined

Feed Flow— Water Pressure Regulator

Another COPES Development

Every important development in feed water regulation during the past 15 years has been brought out first in the COPES. Among these have been the continuous feed, stabilized water level principle; the V-Port control valve; control valves designed for each user's specific operating conditions; a fully balanced control valve; a control valve having adjustable ports; a control valve regulated by a combination of steam flow and water level movement.

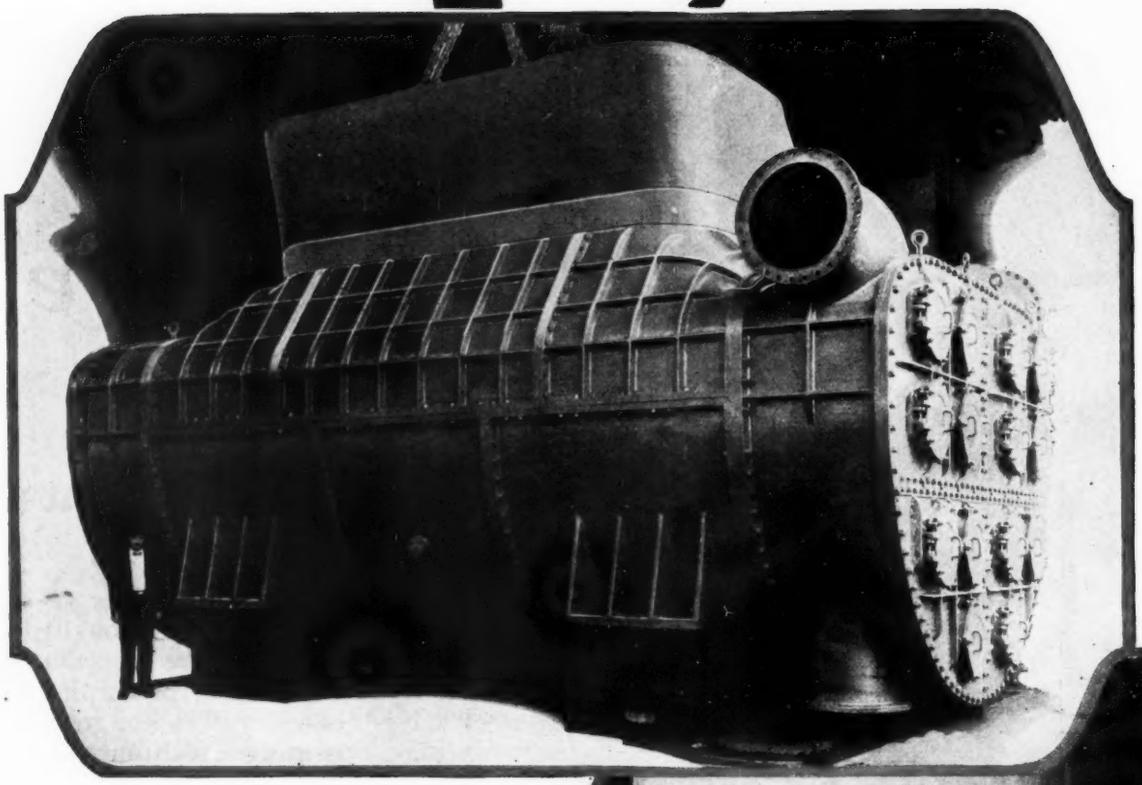
Literature describing the design and operation of the COPES combined feed flow-water pressure regulator, including interesting test data, will be sent on request.

Now— in order that feed water regulation may constantly keep abreast with the requirements of modern steam generation— a new COPES combined feed flow-water pressure regulator has been developed. Its purpose is to accurately control *quantity* and *pressure* in one piece of equipment. Thorough tests have proved the dependability of this latest COPES improvement.

NORTHERN EQUIPMENT CO., 170 Grove Drive, Erie, Pa.

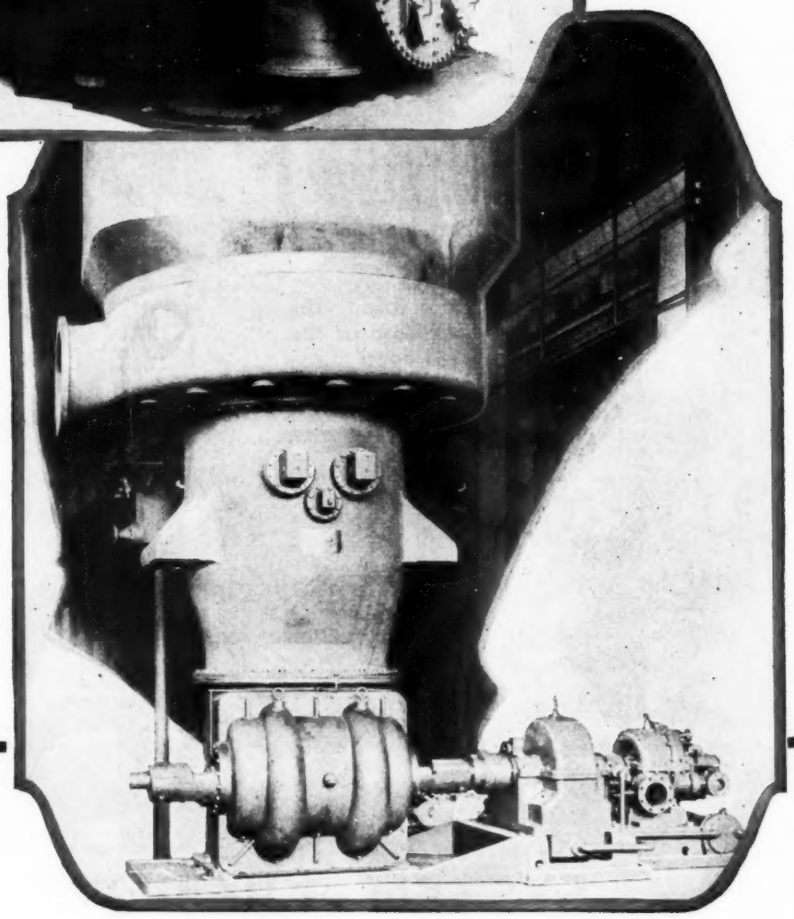
SYSTEM OF BOILER FEED CONTROL

Cond



A 40,000-sq. ft. two-pass twin water-box Surface Condenser

for the Neosho Station of the Kansas Gas & Electric Company. (Built by Phoenix Utility Company.)



A large Jet Condenser

to serve a 15,000-kw. turbine in the largest steel mill in the Pittsburgh District. Many interesting features in the design of condenser and drive.

ensers by ELLIOTT

Economical condenser selection is dictated by maintenance, steam cost, pumping charges, initial investment, and other factors.

In numberless cases, ELLIOTT engineers have applied these factors to the selection of a certain type of condenser and have developed the type selected to meet the operating conditions in every respect.

The experience and hearty co-operation of these men are at your service.

ELLIOTT COMPANY
PITTSBURGH, PA.
General Sales Offices **JEANNETTE, PA.**
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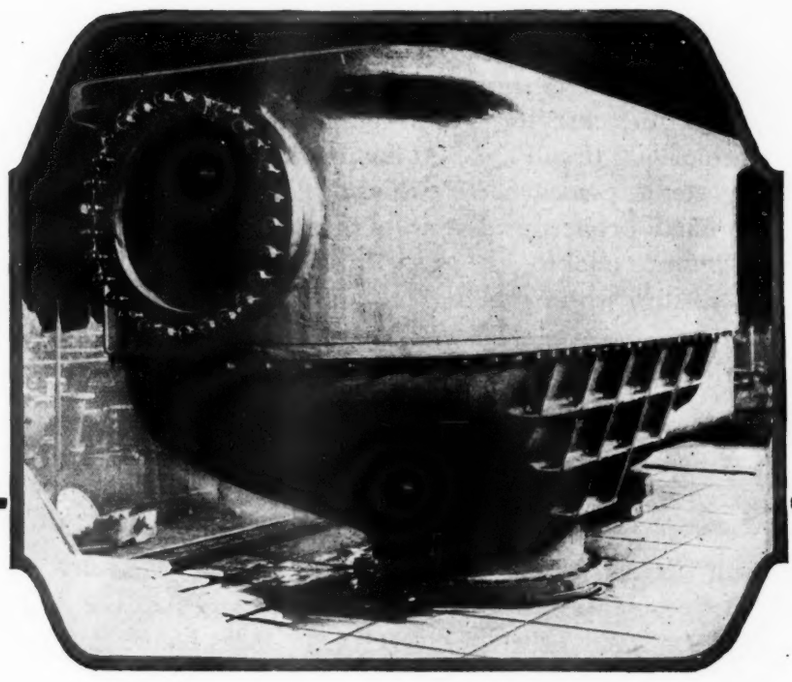
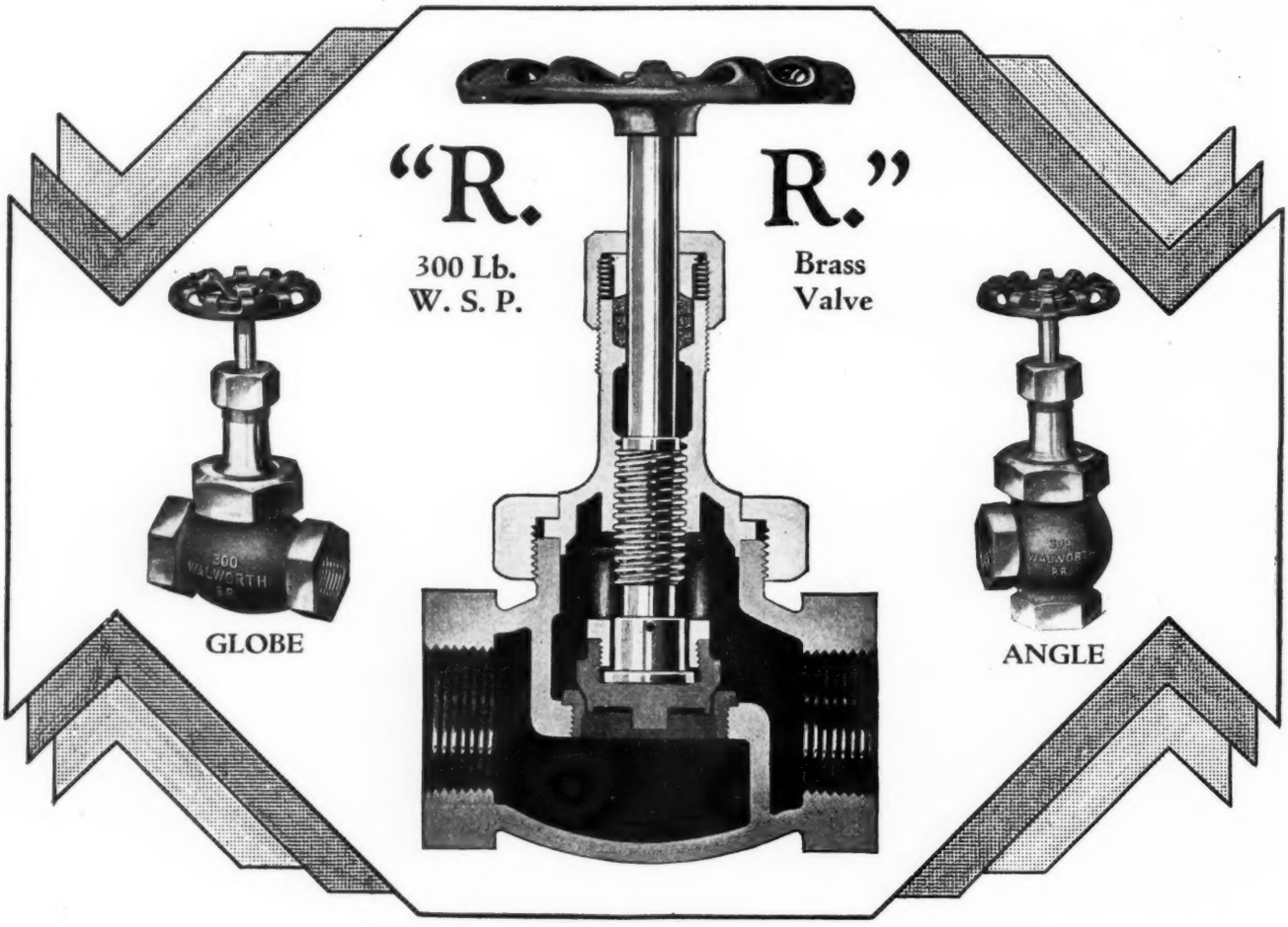


A unique Barometric Condenser

to serve a 15,000-kw. turbine-alternator in a large tube mill in Ohio. One of the largest Barometric Condensers ever built.



Renewable . . . Regrinding

A line which tops the list of superior Walworth brass valves, the R. R. (Renewable and Regrinding seat and disc) is designed for use on steam lines carrying a total temperature of 600 deg. F. at 300 lbs. working steam pressure. Its thick walls of hard bronze and ample thread chamber enable it to withstand vibration, while the Sigmalloy 222 (a nickel-copper alloy) seat and disc, easily removed for renewal purposes, resists the corrosive influences which wreck the working parts of ordinary valves. The Walworth 300 lb. R.R. valves afford a wide margin of safety, to withstand unusual strains of expansion and contraction.

EVERY WALWORTH VALVE IS INDIVIDUALLY TESTED

WALWORTH

Walworth Company, General Sales Offices: 51 East 42nd St., New York
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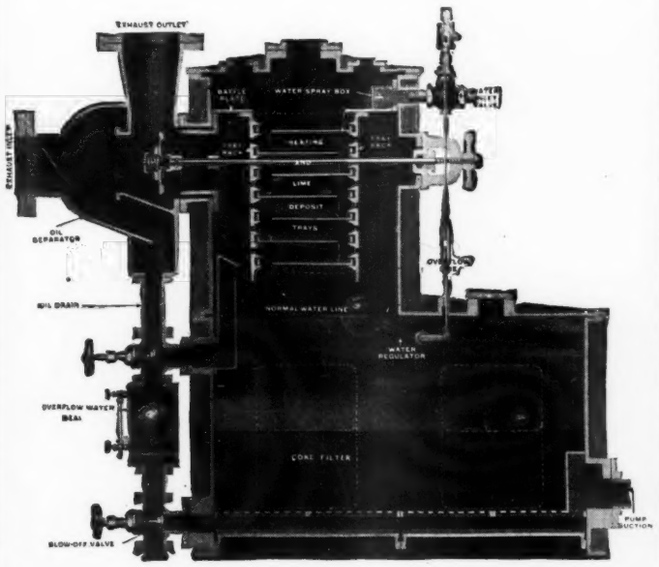
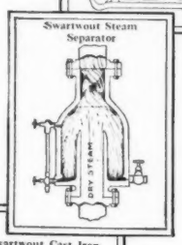
Send for them

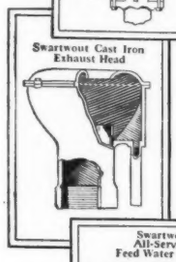
New tables of dimensions on 125-lb. and 250-lb. Cast Iron Flange Standards. Also Walworth Sigma Steel Bulletin No. 6-C, on new steel flanges and flanged fittings.

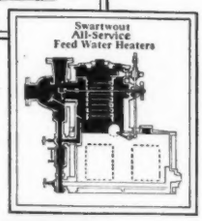
It Grows with your Plant

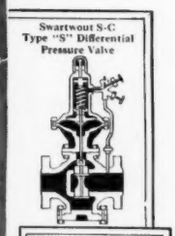


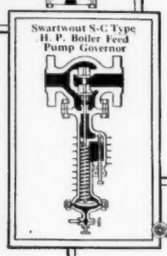
The Swartwout All-Service Feed Water Heater

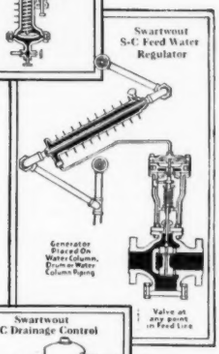


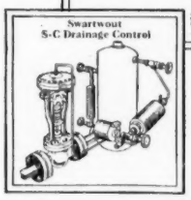









Swartwout S-C Feed Water Regulator
Generator Placed On Water Column, Drum or Water Column Piping
Valve at any point in Feed Line



JUST like a sectional bookcase, The Swartwout All-Service Feed Water Heater can be built up by adding units to take care of expanding requirements. Even the smallest power plant can now have preheated feed water and its resulting advantages without fear of outgrowing the equipment. Two or three units to start with . . . perhaps another unit next year—that is how this equipment grows with your plant. Then there is The Swartwout Junior Feed Water Heater, designed for those plants which have boiler capacity of 250 H. P. or less. Ask for Bulletin S-18.

Swartwout
Controls *and* Regulators

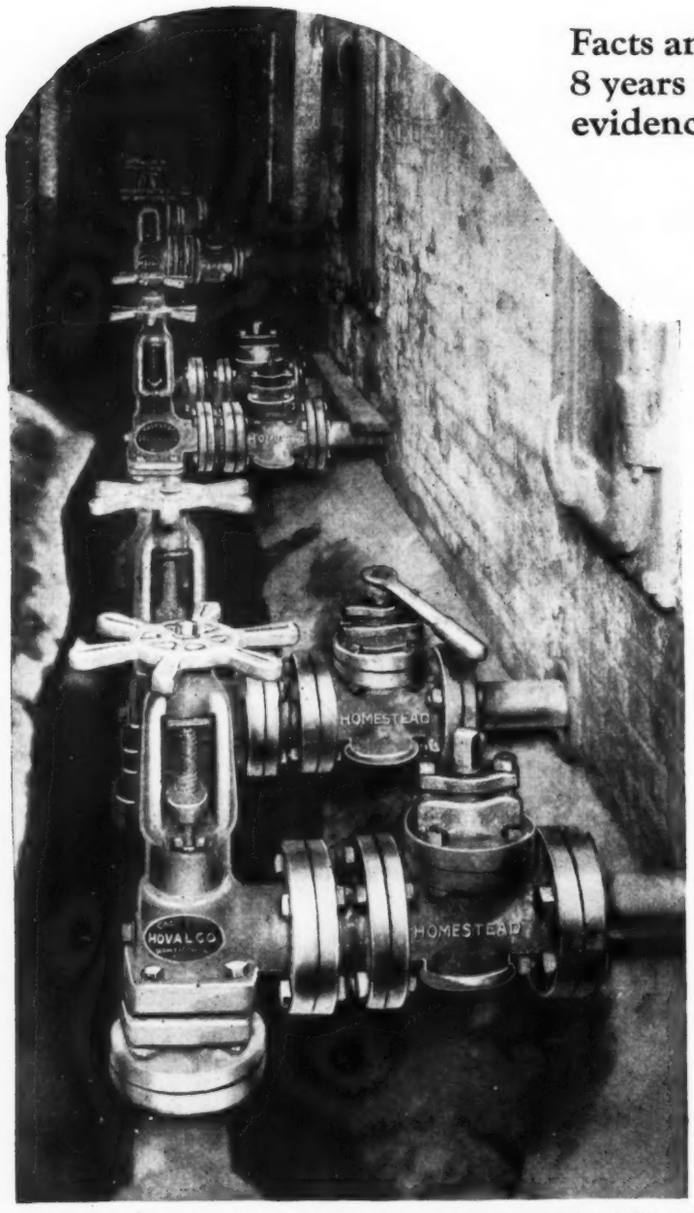
THE SWARTWOUT COMPANY, 18501 Euclid Avenue, CLEVELAND
Please send complete information on the following:

Swartwout	☐ SEPARATORS, AIR, STEAM AND OIL ☐ TRAPS, HIGH AND LOW PRESSURE	☐ CAST IRON EXHAUST HEADS ☐ FEED WATER HEATERS
S-C	☐ FEED WATER REGULATORS ☐ PUMP GOVERNORS	☐ DRAINAGE CONTROL SYSTEMS ☐ DIFFERENTIAL PRESSURE VALVES

*Name*_____ *Address*_____

ECONOMY

from the standpoint of
Initial Investment and Low Maintenance



Facts and figures assembled from Valves 8 years in constant service give concrete evidence of the economy of

Hovalco-Homestead Combination Blow-Off Valves

Actual figures showed Homestead Valves saved $24.71 on a boiler each year as compared to the old valves. This saving is brought about by ease of access and simplicity of construction which permits a full opening with no obstruction to catch dirt, etc. Discs are regrindable, reversible and renewable and the removal of four bolts opens valve up for any maintenance operation.

Summed up you have extremely low maintenance and moderate first cost. A combination that will reduce operating costs—real economy both from the standpoint of investment and upkeep.

Write for descriptive catalog or let us have a nearby representative call.

HOMESTEAD VALVE MANUFACTURING CO., P. O. Box 414, Homestead, Penna.

HOMESTEAD VALVES

QUARTER TURN VALVES:
STRAIGHT WAY
THREE WAY
FOUR WAY
LUBRICATED TYPE
ROUND OPENING REFINERY

PROTECTED SEAT VALVES:
HYDRAULIC (B & O. PAT.) OPERATING
REMOTE CONTROL
GLOBE
ROSS AIR SHUT-OFF VALVE
HOVALCO BLOW-OFF VALVE

You can always get an unbiased report on your combustion problem from a McClave-Brooks Engineer

A McClave-Brooks combustion engineer visits your plant without preconceived opinions. He has no particular type of equipment in mind. He is interested solely in determining what your requirements are—the proper fuel for instance.

When he has completed his study it is a simple matter to select the right equipment from the complete McClave-Brooks line. The net result is a maximum of efficiency—an efficiency that holds costs to their proper proportions.

Our engineers travel the country over year after year. Meeting all conditions from Maine to Texas, they have compiled valuable data. They can show you concrete instances that parallel your own problem. They can show you in hard pan records exactly what McClave-Brooks equipment have accomplished and are now accomplishing.

Arrange to have one of our engineers make a study of your combustion problem. You will not be permitted to feel under any obligation.

McCLAVE-BROOKS COMPANY

Sole Makers of the Famous McClave Grates Since 1883

Main Office and Works: SCRANTON, PENNSYLVANIA

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McClave

COMBUSTION SYSTEMS FOR HIGHEST ECONOMY AND EFFICIENCY IN BURNING *Anthracite Bituminous Lignite*

McClave STOKERS AND GRATES

"FIT THE STOKER TO THE COAL"

THE LEADERS

Some Republic Flow Meter Users

IRON AND STEEL MILLS

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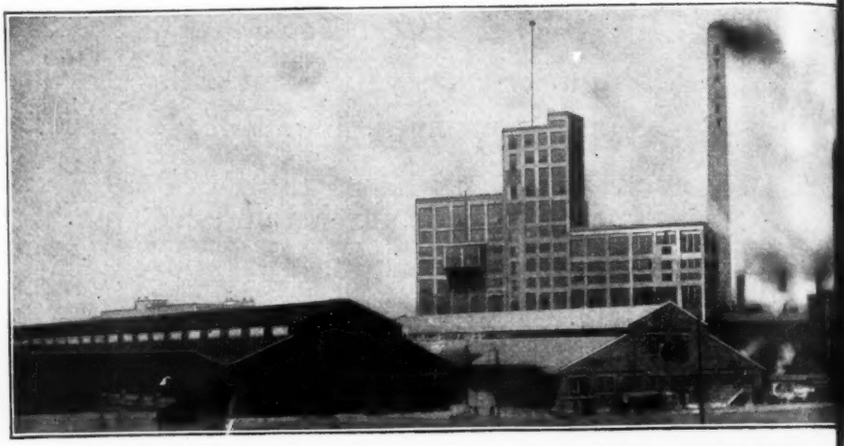
Figures Indicate Number of Meters

At the A. E. Staley Co.,

Republic Meters



General view of the A. E.

How Savings Are Made

When a company has power cost records together with distribution charges based on authentic measurement, **three things happen.**

First,—knowing the facts and feeling certain that their costs and charges for steam consumption are correct, those in charge of departments automatically co-operate to reduce the costs. When the power superintendent receives a statement each month of what each kind of power costs per unit produced, he naturally is the most concerned to cut this cost.

Second,—when the executive department knows the cost of power and knows the amount and by what department the power is used, it can see clearly what progress

ORIGINATORS *of the* ELECTRIC FLOW METER

The REPUBLIC

CO_2 Recorders
Boiler Meters

Draft Instruments
Coal Meters

Indicating Pyrometers
Recording Pyrometers

SPECIFY REPUBLIC

Cut Steam Cost

Staley Co., Plant, Decatur, Ill.

is being made in conservations and reductions of costs of power.

Third,—when the time comes that more steam, electric current or air is required, there is available for use the actual data on which to base the considerations for power additions.

Where accurate records are desired, you will find Republic Flow Meters have been specified.

Bulletin "STEAM ECONOMY" *mailed on request*

REPUBLIC FLOW METERS COMPANY

Executive Offices and Plant · 2222 Diversey Parkway · Chicago, Ill.

Branch Offices in 25 Principal Cities

DOMINION FLOW METERS CO.
Toronto and Montreal
Canada

ELEKTROFLO
Berlin, Germany

ELECTROFLO METERS CO.
Park Royal, London, N. W. 10
England

Some Republic Flow Meter Users

PAPER MILLS

Bogalusa Paper Co.	23
Bryant Paper Co.	48
Canadian International Paper Co.	42
Crown Willamette Paper Co.	23
DeGrasse Paper Co.	13
Flambeau Paper Co.	22
International Paper Co.	16
Kimberly-Clark Co.	18
Manistique Pulp & Paper Co.	10
Marathon Paper Co.	37
Minnesota & Ontario Paper Co.	47
National Paper Products Co.	30
Northern Paper Mills	30
Newfoundland Power & Paper Co.	13
Northwest Paper Co.	30
Pacific Mills, Ltd.	14
St. Lawrence Paper Mills	36
Washington Pulp & Paper Co.	19
West Virginia Pulp & Paper Co.	133
Wayagamack Pulp & Paper Co.	18
Yellow Pine Paper Co.	12

BUILDINGS—HOSPITALS—HOTELS

Battle Creek Sanitarium	5
Bellevue & Allied Hospitals	10
Bellevue-Stratford Hotel	4
City Hall, Chicago	3
Edgewater Beach Hotel	5
Federal Reserve Bank	4
General Hospital, Minneapolis	9
Hotel Morrison	11
New Trier High School	7
Palmer House	9
Rookery Bldg.	7
Roosevelt Hotel	3
Hotel Sherman	7
Stevens Hotel	8
Tribune Tower Bldg.	1

CHEMICAL PLANTS

Aetna Explosives Co.	5
American Potash & Chemical Corp.	19
Carter White Lead Co.	6
Dow Chemical Co.	6
E. I. DuPont De Nemours & Co.	136
Grasselli Chemical Co.	54
Hercules Powder Co.	27
Maywood Chemical Co.	10
Merrimac Chemical Co.	14
Redmanol Chemical Co.	6
Sherwin Williams Co.	16
Trojan Powder Co.	6
Textile Dyeing Co.	6
United Piece Dye Wks.	20

TEXTILE MILLS

American Woolen Co.	28
Bellman Brook Co.	11
Bigelow-Hartford Carpet Co.	24
Mt. Hope Finishing Co.	33
Sanford Mills	26
Standard Bleachery Co.	16
Utica Willowvale Bleachery	10
Wyandotte Worsted Co.	14

RAILROADS

A. T. & S. F. R. R.	16
C. B. & Q. R. R.	10
C. & N. W. R. R.	2
Illinois Central R. R.	3
Norfolk & Western R. R.	3
Pullman Car Co.	4
Reading Lines	35

Figures Indicate Number of Meters

FLOW METERS

Republic Meters

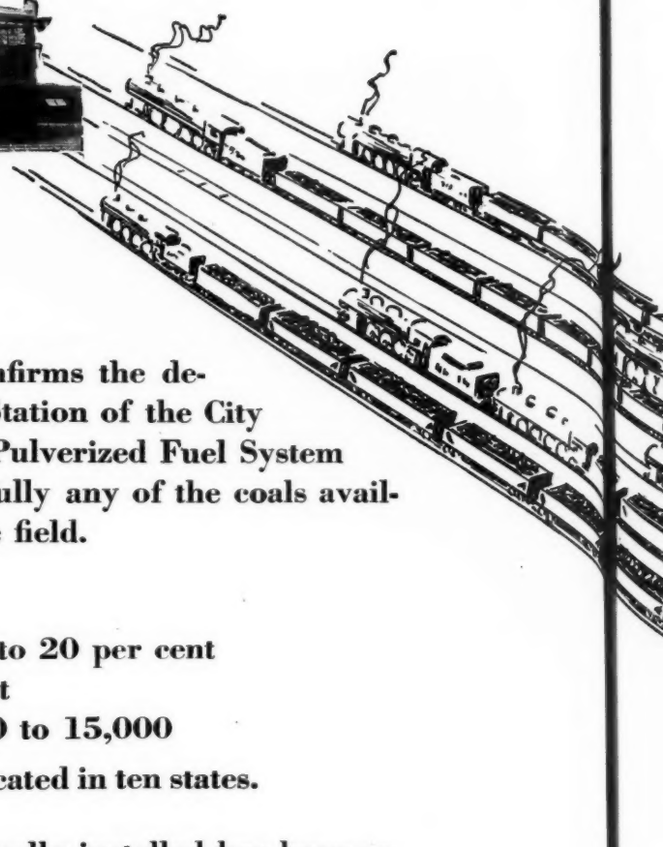
Liquid Level Indicators
Liquid Level Recorders

Gas Meters
Air Meters

Water Meters
Steam Meters

This Lopulco

Big Sioux Station of Sioux City Gas & Electric Co.
The U. G. I. Contracting Company, Philadelphia,
Contractors and Builders



TWO YEARS' operating experience confirms the designers' conclusions at the Big Sioux Station of the City Gas & Electric Company that the Lopulco Pulverized Fuel System is the correct method of burning successfully any of the coals available at a truly competitive price in a wide field.

These coals varied—

in moisture content from 2 to 20 per cent
in ash from 9 to 24 per cent
in B. t. u. values from 8,700 to 15,000

and were purchased from fields located in ten states.

The performance of the three units originally installed has been so satisfactory that a fourth unit has recently been added.

• • •

This organization is in a position to analyze any fuel burning or steam generating problem from an unbiased standpoint. A request for an analysis of your problem involves no obligation on your part whatever.

COMBUSTION ENGINE

INTERNATIONAL COMBUSTION BUILDING

A SUBSIDIARY OF INTERNATIONAL

Installation
uses Coal from Ten States

Excerpts from articles describing this plant:

Power Plant Engineering

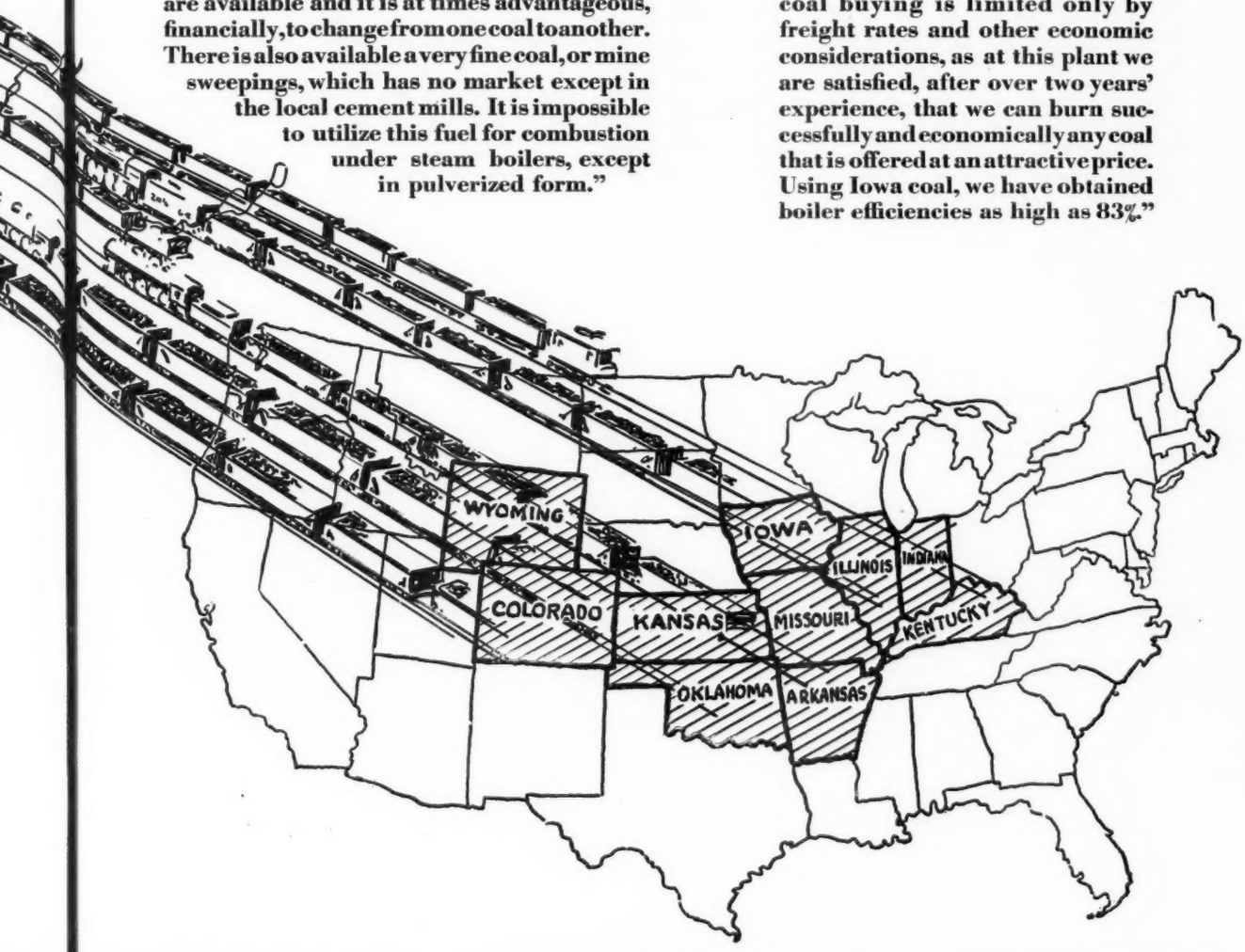
October 15, '25

"In this district fuels of widely varying quality are available and it is at times advantageous, financially, to change from one coal to another. There is also available a very fine coal, or mine sweepings, which has no market except in the local cement mills. It is impossible to utilize this fuel for combustion under steam boilers, except in pulverized form."

Power Plant Engineering

May 1, '28

"For us the competitive field of coal buying is limited only by freight rates and other economic considerations, as at this plant we are satisfied, after over two years' experience, that we can burn successfully and economically any coal that is offered at an attractive price. Using Iowa coal, we have obtained boiler efficiencies as high as 83%."



ERING CORPORATION

200 MADISON AVENUE, NEW YORK, N. Y.

COMBUSTION ENGINEERING CORPORATION

4 BIG REASONS *why* Consolidated Safety Valves *are* Universally Used

Consolidated Safety Valves

DSA—Steam Pressure 350 to 500 lb.
DSB—Steam Pressure 500 to 750 lb.
DSC—Steam Pressure 700 to 1500 lb.

first "Consolidated," with its 1200-lb. boiler equipment and testing laboratory, has been able to design a complete line of safety valves to meet every operating condition.

second Consolidated Safety Valves are easy to adjust if you desire to change popping point or blow down.

third They open cleanly at the set popping pressure and close cleanly at the set closing pressure.

fourth They can be repaired easily by any first-class machinist.

Every Consolidated Safety Valve is tested under actual operating conditions, before shipment, in the Consolidated Ashcroft Hancock high pressure steam testing laboratory—an assurance of successful performance.

CONSOLIDATED ASHCROFT HANCOCK COMPANY, Inc.

Subsidiary of Manning, Maxwell and Moore, Inc.

100 E. 42nd ST., New York City

Western Sales Office—29 N. Jefferson St., Chicago

TWO BULLETINS

Worth Having

. . . and worth a careful reading too.

The Hagan System of Steam Purification is described in these very interesting and informative publications. The Hagan System *guarantees* clean, dry steam by a simple, fool-proof, economical method.

If you have a wet steam problem, ask for these booklets. There is no obligation.

HAGAN CORPORATION

Combustion and Chemical Engineers

PITTSBURGH, PA.

502 BOWMAN BUILDING

Sales and Service Offices in All Principal Cities of America

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Use this coupon

HAGAN

Steam Purification

SYSTEM

You'll profit by reading *"Clean Dry Steam"* and *"The Wet Steam Problem."* Send for them today. (502)

Name .....

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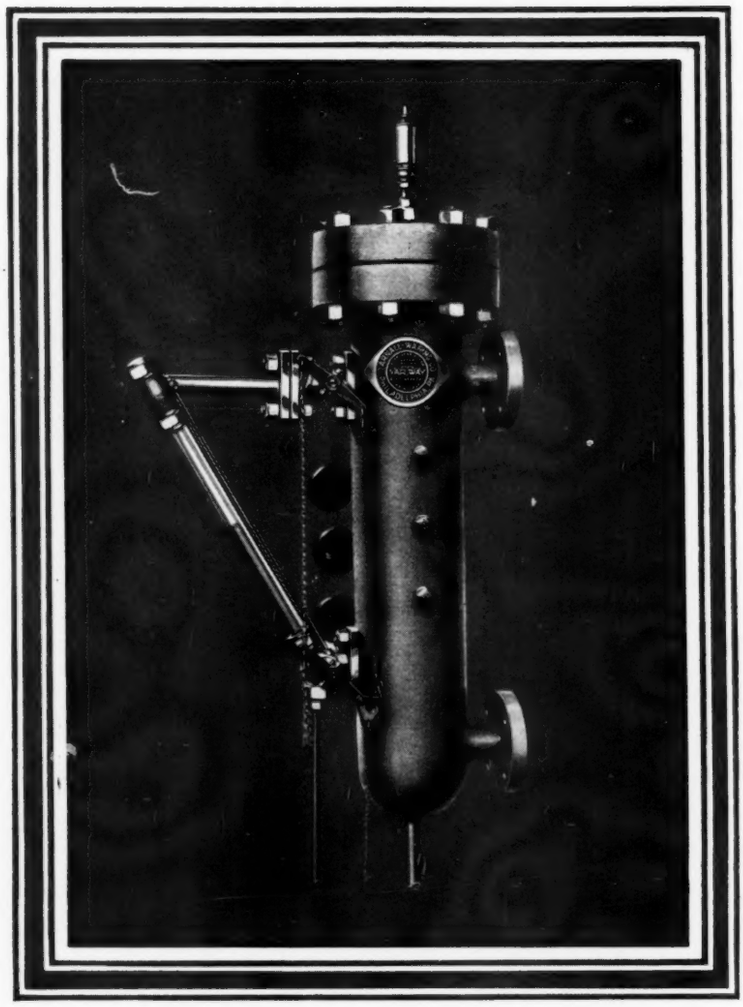
YARWAY FLOATLESS HI-LO ALARM WATER COLUMN with YARWAY SE-SURE INCLINED WATER GAGE (Fig. 4110-52). For 400 lbs. working pressure.



Are they on

The installation of a Yarway Floatless Hi-Lo Alarm Water Column with a Yarway Se-Sure Inclined Water Gage adds an increased factor of safety and easy operation to any boiler, whatever its size or working pressure.

The Yarway Floatless Hi-Lo Alarm Water Column operates on the displacement principle without hollow floats. It is provided with a high and

YARWAY

YARWAY TYPE E SE-SURE INCLINED WATER GAGE, for working pressures up to 400 lbs.

YOUR Boilers?

low whistle alarm operated by a single valve. Also furnished with a light or bell signal if desired. Body is of gray iron or forged steel depending upon the working pressure. Made in a variety of types for all pressures to 600 lbs.

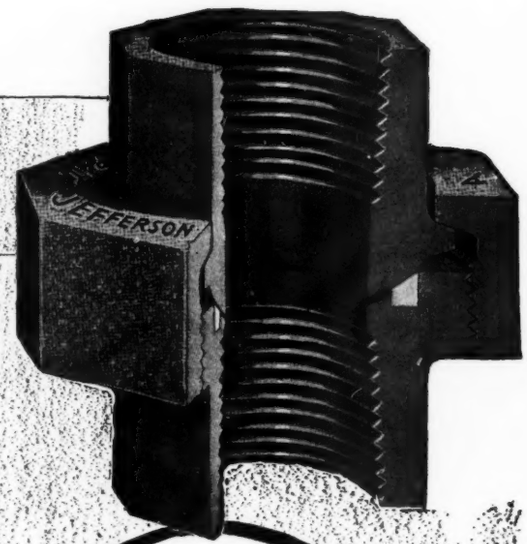
The Yarway Se-Sure Inclined Water Gage insures positive visibility of water levels from any angle — even directly beneath. Standard equipment for the Water Column and also sold as a separate unit. For all pressures to 600 lbs.

Yarway Water Columns and Gages in all types for all pressures are illustrated and fully described in Bulletin WC1801. It will be sent at your request.

YARNALL-WARING COMPANY
Mermaid Avenue • • Philadelphia

BOILER DEVICES

Lexington is known for its Minute Men of 1775 and being the home of Jefferson Unions



The Beginning of Freedom

Freedom from leaks at union-points in steam, gas, oil, water and air lines begins with the installation of Jefferson Unions. The remarkably successful performance of these splendid unions in thousands of power plants under every conceivable operating condition evidences the dependable tightness of Jefferson Unions at all times.

Every leading jobber can supply you with Jefferson Unions, as we have distributors in every industrial center.

Jefferson Union Co.
Lexington, Mass., U. S. A.

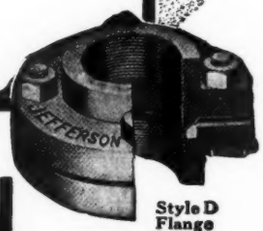
SPECIAL FEATURES

Made of Air Refined Malleable Iron.

Brass Seat Ring located in a recess away from the runway of the fitting.

Briggs tapered pipe threads—sharp, clean, smooth and accurate.

Joints ground in pairs, after which they are never separated, thus assuring tight joints.



Style D Flange Union

JEFFERSON UNIONS

Beating The Fire Devil

WITH *Drop Forged Steel* Vogt VALVES & FITTINGS

Don't gamble on inferior valves and fittings. You ultimately pay for them many times over through loss of time, product, life and property. You have positive assurance of eliminating the fire hazard when using Vogt Drop Forged Steel Valves and Fittings. ***Write for Bulletin F-6***

"BUY THE BEST FIRST"

HENRY VOGT MACHINE CO.
(Incorporated)
LOUISVILLE, KY.

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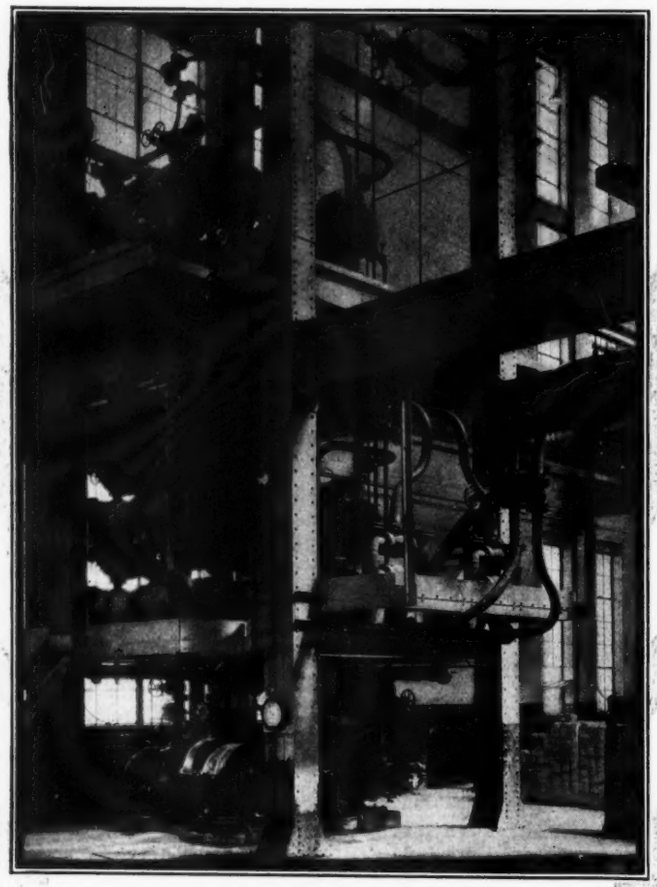
Manufacturers of: Oil Refinery Equipment, Drop Forged Steel Valves and Fittings, Water Tube and Horizontal Return Tubular Boilers, Ice Making and Refrigerating Machinery.

BRAUN

HEAT EXCHANGERS FOR YOUR PLANT



C. F. BRAUN & CO.

MANUFACTURING
CHEMICAL ENGINEERS

ALHAMBRA • CALIFORNIA

NEW YORK CHICAGO TULSA
DALLAS HOUSTON

Braun heat transfer apparatus operates smoothly and efficiently at a lower cost per B.T.U transferred than any other type of similar equipment.

Backed by an honest interest in your problems

The Plastic Refractory that is DIFFERENT

In addition to the 10 exclusive advantages of RAMTITE the following 8 points are unique in the organization and policies backing this material.

1. Half a century of experience.
2. An engineering service that is genuine.
3. Successful installation methods.
4. Reliable local representatives.
5. A financially stable and long established house.
6. Reserve stocks that assure prompt shipment.
7. Policy that refuses to sell when the material is not suitable.
8. An honest interest in your problems.

YOU CAN bring your furnace lining troubles to the S. Obermayer Co. with the confidence that a sincere interest will be taken in your problem and that no effort will be spared in giving you the benefits gained by more than 50 years' experience with refractories.

The S. Obermayer Co. realizes that modern combustion methods have greatly increased the severity of service on furnace linings, and that new types of refractories are necessary to meet these conditions. RAMTITE plastic monolithic furnace lining was developed to resist the destructive effects of intensive combustion in modern furnaces.

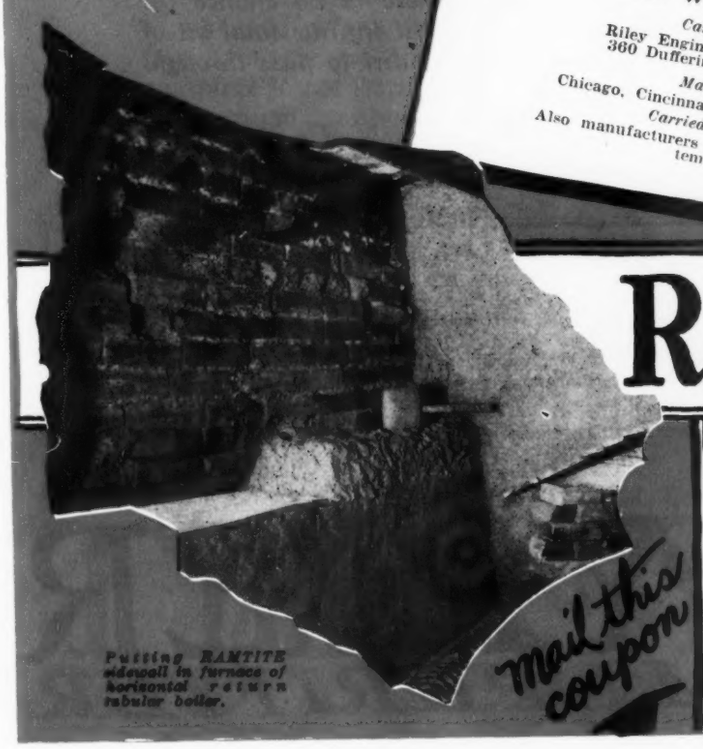
Its superiority has been proved by the service it has given and is giving in hundreds of installations of various types. It will outlast fire brick two and three times and will save you money and trouble. Investigate RAMTITE—it is worth while.

The S. OBERMAYER COMPANY
2563 W. 18th Street, Chicago

Canadian Distributors:
Riley Engineering and Supply Co., Ltd.
360 Dufferin Street, Toronto, 3, Canada

Manufacturing Plants:
Chicago, Cincinnati, Pittsburgh, Springfield, Mass.
Carried in stock in 26 cities.
Also manufacturers of HOTT-PATCH and other high temperature cements.

RAMTITE



Putting RAMTITE sidewall in furnace of horizontal return tubular boiler.

mail this coupon

Please have your nearest representative give me further information on RAMTITE furnace linings.

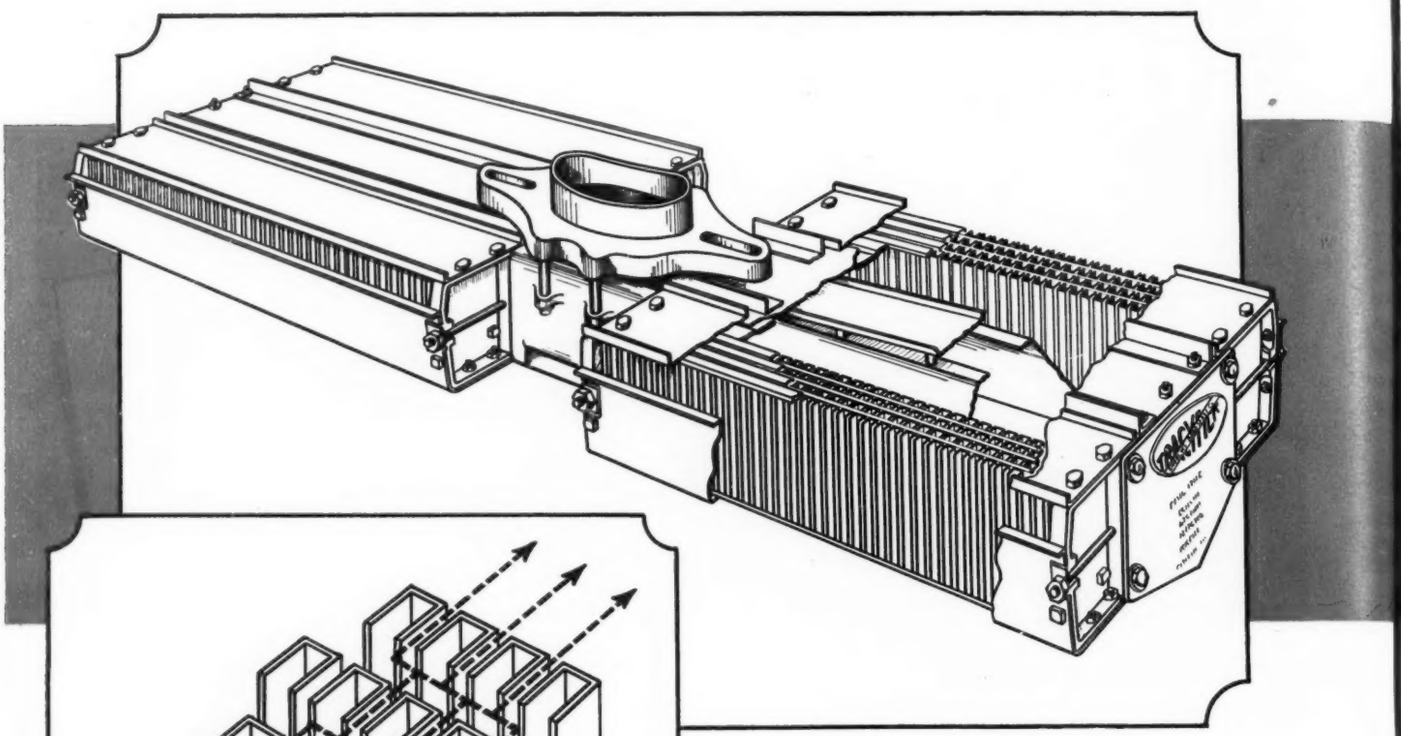
Name.....

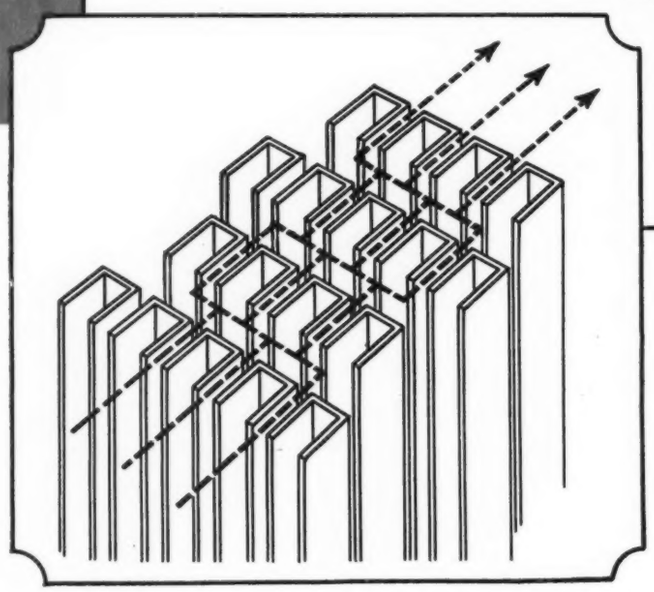
Address.....

Company.....

Position.....

The Facts About





This cut-away view of the Tracyfier is designed to show the multitude of baffles which the steam must encounter before it leaves the boiler. There is no chance for even the most infinitesimal bit of moisture or dirt to pass through.

***STANDARD SPECIFICATION STEAM**

Steam shall be free from all solids—both soluble and insoluble. Samples of condensed steam shall not show more than nine parts total solids per million, which is the tolerance to cover dissolved copper and iron from the test condenser, unavoidable dust contamination during the collection of the sample and its evaporation and unavoidable errors in the laboratory determination of total solids.

Steam shall be free from all moisture. Throttling calorimeter tests shall at all times show 100% dry steam, + or — not more than 2-10ths of 1%, based on the determined normal of the calorimeter. The permitted variation of + or — 2-10ths of one per cent is the tolerance for unavoidable variations in radiation and thermodynamic changes.

TRACYFIER

THE STEAM PURIFIER

Steam Purification

and a few pertinent points about the TRACYFIER

STEAM purification means the removal of every last bit of impurity and moisture from the steam before it leaves the boiler. Anything less than this is not steam purification and should not be considered.

The Tracyfier is the only steam purifier that removes, year in and year out, the last fraction of 1% of dirt and moisture from the steam, giving **Standard Specification Steam.*

It is this last fraction of 1% that counts, and the *provable* savings made by the Tracyfier usually repay the investment in from seven to seventeen months.

Tracyfiers are designed and manufactured for the work they are intended to do. The finest machine work possible is necessary to accomplish the accurate, careful construction that determines the difference between real steam purification and a compromise.

The cost of Tracyfiers is eminently just and fair, and includes only a legitimate profit for the manufacturer.

Send for Bulletin No. 1050 entitled, "A Cubic Foot of Steam Visualized," which explains in detail how the Tracyfier, employing four scientific and approved methods of separation, really does the complete job of purification that makes their installation profitable to you no matter how good your steam plant.

ANDREWS-BRADSHAW CO.

DIVISION OF

BLAW-KNOX CO.

651 Farmers Bank Bldg. Pittsburgh, Pa.

TRACYFIER

THE STEAM PURIFIER

Superior thermal characteristics

In G-E Power Transformers the hottest spots are cool

NOT only is the temperature rise, as measured by resistance, within the limit set by the standards of the American Institute of Electrical Engineers, but the ***maximum observable hot-spot temperatures*** also conform to these standards. These facts have been proved by many tests on G-E transformers of every class.

The small differences between the measurement of temperature by resistance and by the embedded-detector method show the effectiveness of the oil circulation in cooling all parts of the windings and core thoroughly and uniformly.

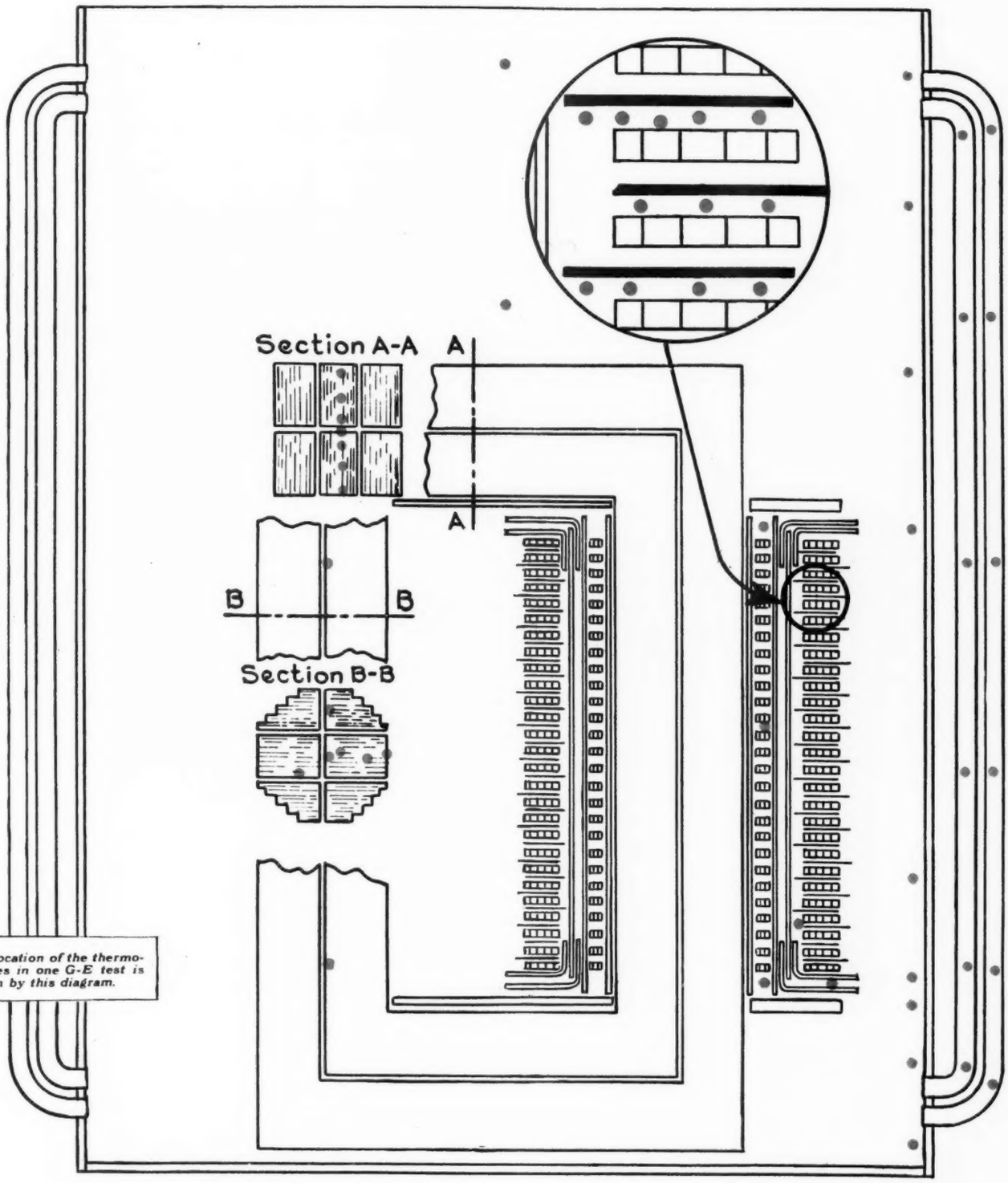
The life of a transformer depends upon the life of its insulation, which, in turn, is largely determined by the temperature of the hottest spot. The practical elimination of hot spots has been solved by the circular-coil design used in G-E power transformers.

The tests mentioned here are a regular part of the intensive investigation continually being carried on to improve and to verify the design of G-E circular-coil, Type-H transformers. G-E transformer specialists will give you other facts regarding G-E design.

GENERAL

GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

shown by tests

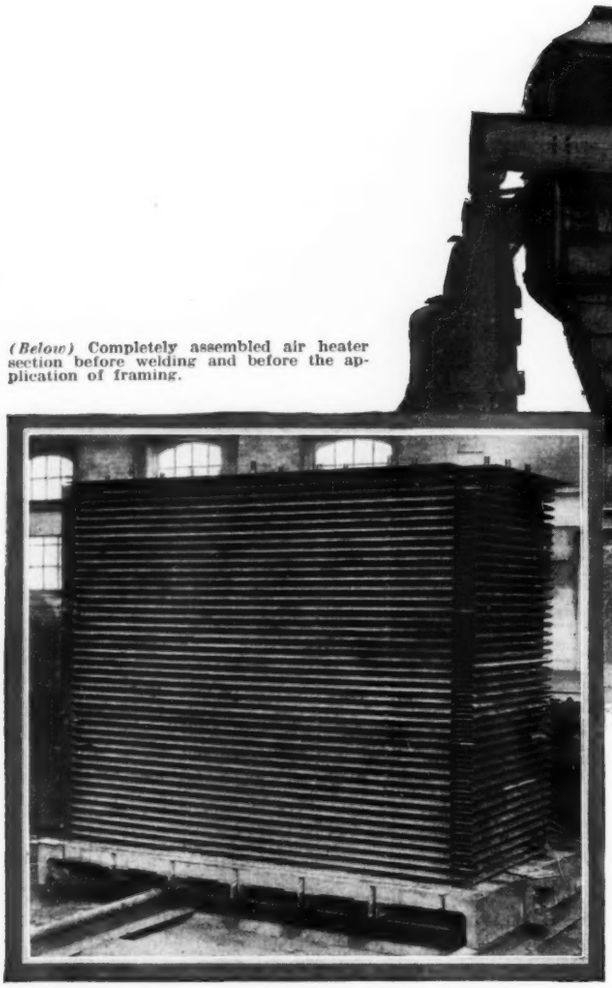


The location of the thermo-couples in one G-E test is shown by this diagram.

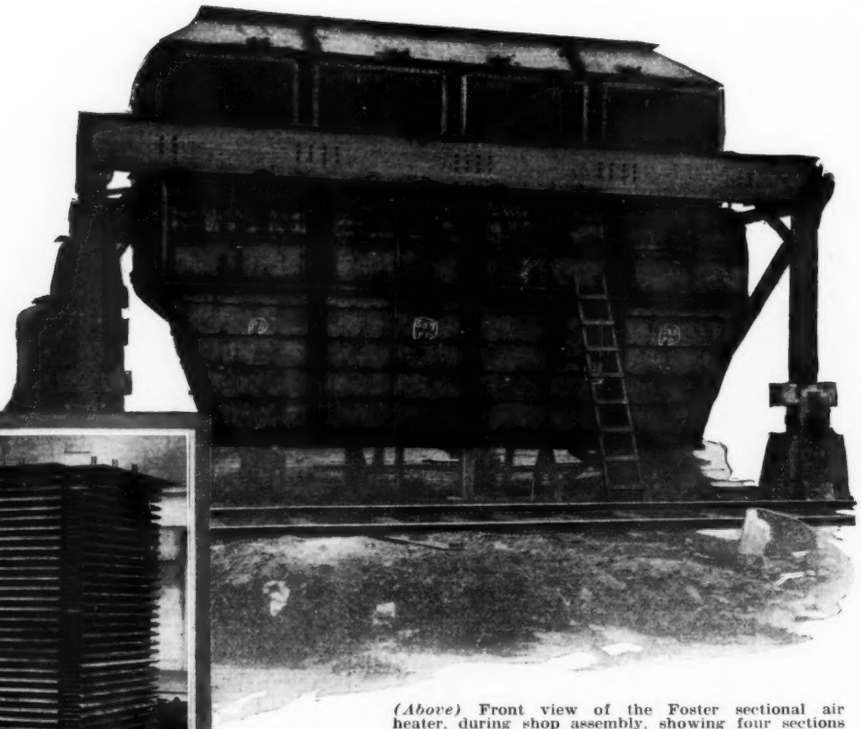
410-14

ELECTRIC

SALES OFFICES IN PRINCIPAL CITIES



(Below) Completely assembled air heater section before welding and before the application of framing.



(Above) Front view of the Foster sectional air heater, during shop assembly, showing four sections arranged in parallel and two rows high.

Foster Sectional

(Haber

The Foster sectional air heater embodies new principles of design for preheating the air used in combustion. A complete heater consists of heating surface assembled in a number of interchangeable sections. These are assembled at the shop. The sections are shipped after testing and are bolted together on the job. The design thus provides for doing most of the work where it can be best done and the least work where the cost is highest.

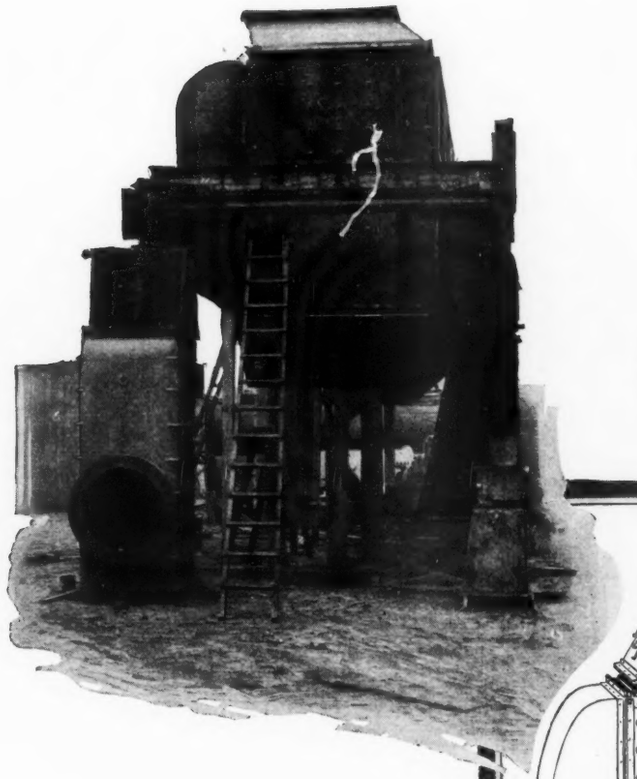
Each section consists of a series of steel sheets welded together, alternately at the sides and ends, so that every other space carries air to be heated and the intervening spaces carry hot flue gases.

The accompanying illustrations show shop construction and assembly of a Foster sectional air heater designed for two pass air flow. It is two sections high and four sections wide.

Flue gases pass straight up thru the two rows of sections arranged one row above the other. The air to be heated enters the four top sections in parallel, passes horizontally through them and down

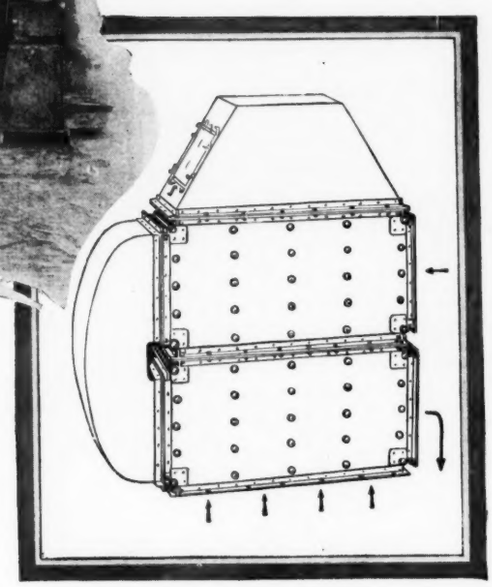
AERO UNIT COAL PULVERIZERS
AIR HEATERS CENTRIFUGAL PUMPS
CONDENSERS COOLING TOWERS
ECONOMIZERS EVAPORATORS
EXPANSION JOINTS FEED WATER HEATERS

FOSTER



End view of the air heater showing upper and lower sections with connecting air duct at the left. Gases flow straight up through the sections.

(Below) Diagrammatic sketch of the air heater illustrated. Air centers at right horizontally and flows through the upper sections in paralled, then down through connecting-ducts and horizontally through lower sections, discharging downward on the right hand side to the furnace.



Air Heaters

Patents)

the connection ducts to the four lower sections. This arrangement, employing counter-current flow of air and flue gases, assures maximum heat transfer for the unit.

The air heater illustrated above contains 12,000 sq.ft. of heating surface. It is designed to raise the temperature of 250,000 lb. of air for combustion 124 deg. F. while cooling the flue gases from 400 deg. to 294 deg. F.

Installations of Foster sectional air heaters are showing 5 to 10 per cent saving in fuel and 10 to 20 per cent increase in boiler capacity.

FOSTER WHEELER CORPORATION

165 Broadway, New York, N. Y.

Branches in Principal Cities

Foreign Associates:
Foster Wheeler Limited: London, England
Foster Wheeler Limited: Toronto-Montreal-Vancouver, Canada

WHEELER

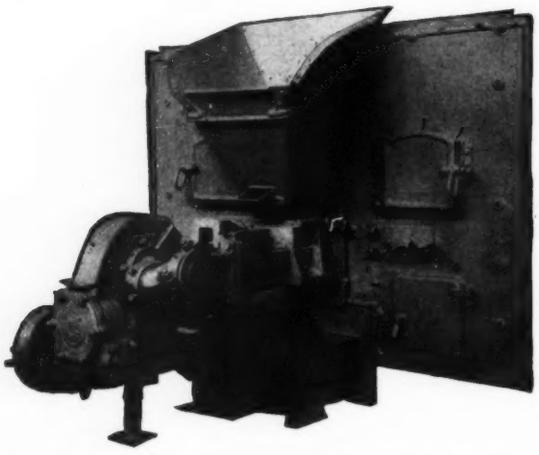
FRACTIONATING TOWERS HEAT EXCHANGERS
STEAM JET AIR PUMPS SUPERHEATERS
TUBE STILLS VACUUM PUMPS
WATER COOLED FURNACE SURFACES
BRASS AND COPPER TUBING AND PIPE

Jones Side Dump Stokers

Air-Zoned *and* Mechanically-Driven

(2-Speed Riley Gear Box is Used)

Cut showing Air-Zoning Damper for controlling air to sloping combustion grates and plow shaped rear dead plate for prevention of clinker to bridge wall.



New Jones Stoker Unit with Electric Driving Motor, Fuel Feeding Mechanism and Forced Draft Equipment combined into one compact unit.

FOR many years air to the overfeed section of multiple retort stokers has been under damper control. This section has been air zoned from the remainder of the stoker because air regulation to this section is particularly important. Now, this feature has been applied to Jones Side Dump stokers with surprising increase in efficiency.

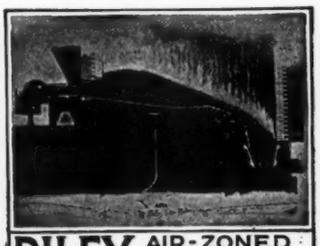
Another new feature of Jones Side Dump Stokers is the use of the Riley 2-speed Gear Box on Jones Mechanically Driven Stokers. This adds real fuel control to the complete air control afforded by air-zoning dampers. Is it any wonder that Jones Side Dump Stokers today are operating at efficiencies near the eighty per cent mark? Efficiencies unthought of several years ago for single retort stokers.

Send for Bulletin P-284

RILEY STOKER CORPORATION

9 Neponset Street, WORCESTER, MASS., U. S. A.
Riley Engineering & Supply Co., Ltd., Toronto, Canada

ATRITA UNIT PULVERIZER

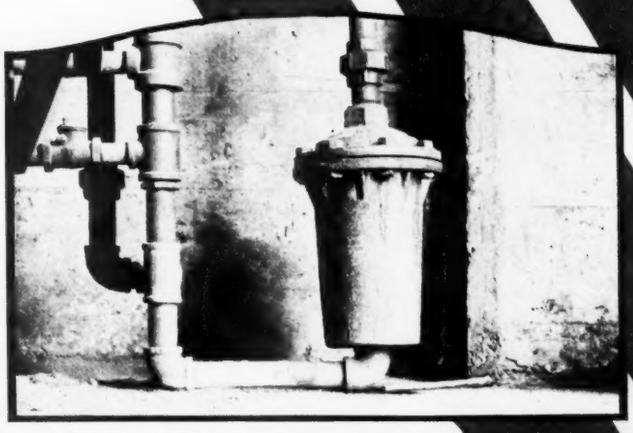


RILEY AIR-ZONED SUPER-STOKER

JONES UNDERFEED STOKERS

HARRINGTON TRAVELING-GRATE STOKERS

Armstrong Steam traps are self-contained units



This is a typical complete Armstrong trap installation. The parts are simple and there is nothing to get out of order. That is why years of uninterrupted service is common among Armstrong Traps.

THEY are small in size, light in weight, and require no special fittings or supports. They are merely inserted in the line. When you buy an Armstrong you do not have to buy pedestals, brackets, special fittings, strainers, drain cocks, etc. to make a complete installation, and then spend a lot of time keeping them in working condition.

Armstrong Traps are self-contained automatic units. They are self-cleaning, discharging air, oil and dirt with the condensate. Due to their small size and symmetrical features they fit in anywhere and make a neat installation.

The unique construction provides a water seal at all times and no live steam can get to the valves. That is just another assurance of maximum economy. Each part is made of a carefully selected material and generously proportioned to eliminate trouble and resist wear. For example, valves and seats are made of a special heat treated chrome steel.

The various advantages of Armstrong Traps can best be appreciated by testing one. You can do it without cost to yourself; simply send the coupon.

Armstrong Machine Works
312 Maple Street
Three Rivers, Michigan
District Representatives in 36 Cities

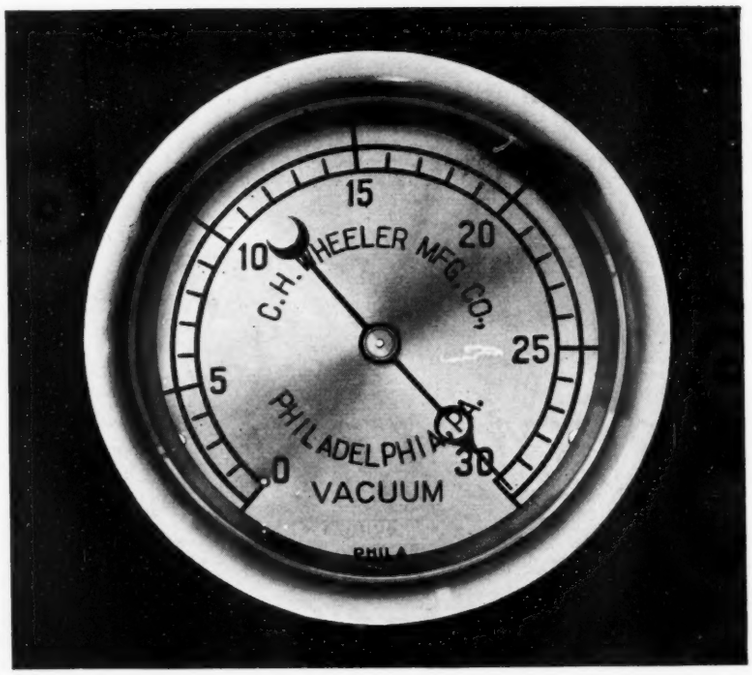
ARMSTRONG
TRADE MARK
"INVERTED BUCKET"
STEAM TRAP

P6-26Gray

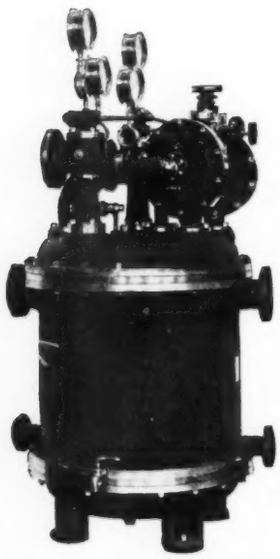
90 days trial—

Armstrong Machine Works,
312 Maple St., Three Rivers, Mich.
Please ship prepaid an Armstrong Trap for a 90-day test. When the test is completed the trap will be returned collect.

For service on _____ Steam Pressure (Maximum) _____
Size of pipe _____
Name and Position _____
Firm _____
Street Address _____
and State _____
Catalog.



Vacuum Approaching the Theoretical



Two two-stage RADOJET Air Pumps on a combined Surface Inter- and After-Condenser.

We also manufacture:

Surface, Jet and Barometric Condensers; Leach Fracto Condensers; Oil Vapor Condensers for High Vacuum Distillation; Heat Exchangers; Forced and Natural Draft Cooling Towers.

An absolute pressure of O.m.m., the theoretical perfect vacuum, still lies beyond the boundary line between theory and practice; it is as unattainable as infinity.

The RADOJET Air Pump, developed by C. H. Wheeler engineers, approaches this condition of entire absence of pressure to a degree as economically practical as is possible. RADOJETS have been in operation for years, maintaining 3 m. m. Hg. absolute pressure, doing it consistently and dependably with a minimum of attention and upkeep cost.

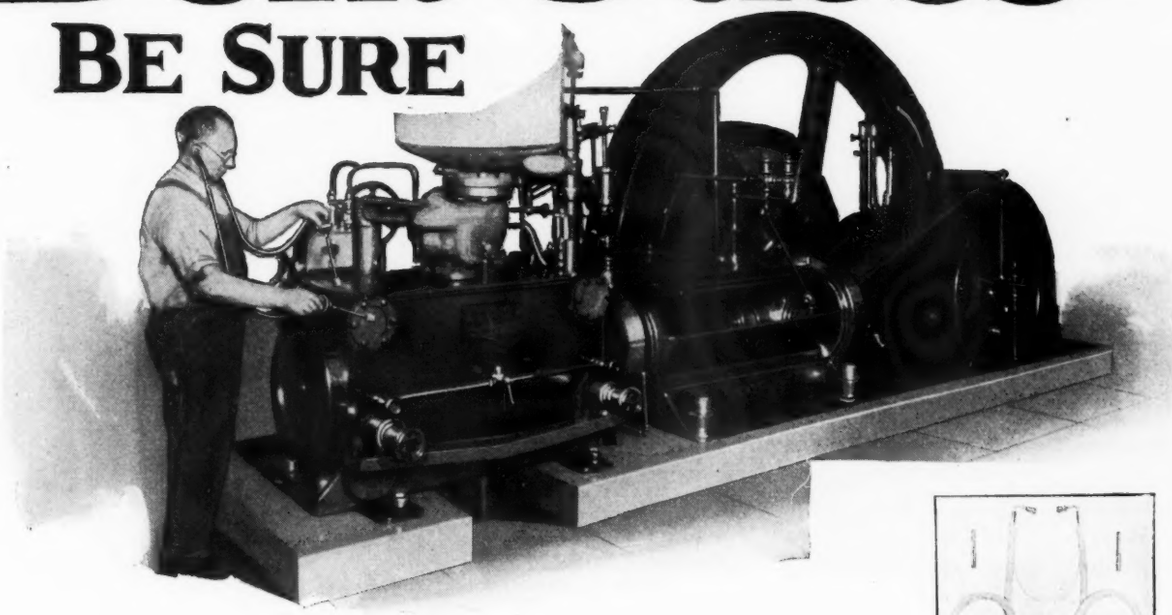
The RADOJET, the highest development in steam air ejectors, is furnished in single or multi-stages, depending upon the degree of vacuum required. It has been successfully employed in every field employing vacuum in any of its processes.

Our engineers are pioneers in the development of this type of equipment. Let us send a booklet illustrating and describing the application of all types of the RADOJET, or, if your particular requirements are unusual, ask us for specific information.

C. H. WHEELER MFG. COMPANY
19th St., Lehigh and Sedgley Avenues
Philadelphia

C.H.WHEELER of PHILADELPHIA

Don't Guess — BE SURE



The Modern Power Plant Engineer Should Not Guess!

He should be sure of every move he makes in the operation of his plant—
SAVE MONEY, TIME and EFFORT with this EFFICIENT TOOL.

The TRANSMIT-O-PHONE (TRADE MARK, PATENTED)

Locates and Identifies Power Plant Machinery Troubles

Quickly and positively traces source of abnormal sounds and vibrations in Engines, Pumps, Ammonia and Air Compressors, in fact everything used in a modern power plant, fine for Turbines, etc. Adds SUPER-SENSITIVENESS to the human ear. No wasteful guesswork methods. The Transmit-O-Phone shows up where the real trouble originates at once.

Also used to:

Locate Hidden pipe lines, Leaky Valves, Drain or Sewer Pipe stoppages, leaks in pipe lines, Defects or knocks in Gas Motors, Gears, etc., Defects in all Depts. connected with Water Works, Plumbing and Heating lines.

Easy to Operate Our directions make it easy for anyone to operate the Transmit-O-Phone. With a little practice, a high degree of proficiency can be obtained. Instrument or tool comes complete as per cut, with all attachments, ready to use, in neat case. Made of the finest materials obtainable, will last a life time. Costs nothing to operate.

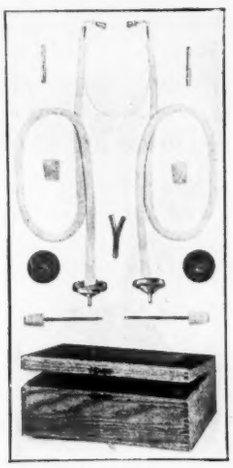
New "Twin" Model

Exclusive features make it possible to hear sounds from two different places separately and distinctly with this new model. Gives absolute accuracy in running down defects and troubles.

Low Cost Compared with usefulness and savings effected, our price is surprisingly low. A large number of the biggest Tool-making and Engine-building concerns in this and other Countries are using TRANSMIT-O-PHONES in their own plants, every Transmit-O-Phone user becomes a booster.

ARE YOU still hanging on to the Tallow Candle Age — in trying to locate the exact spot (source) of unnecessary sounds and vibrations in your Power Plant with make-shift and antiquated devices—or do you stand for and encourage Economic and Scientific Progress.

International Metal & Specialty Co.
24-28 Central Ave., Berlin, N. J.



Above is a miniature picture of one of the most versatile and economical tools ever offered to the Engineering and Mechanical lines and at the price we sell same makes it the biggest values ever offered in any mechanical line.

The TRANSMIT-O-PHONE Costs Only $15.00 Delivered to Your Address

Pin COUPON below to your business letterhead; we will ship it on 3 days' approval and invoice same with the understanding, if you are not convinced of its merits, return both at our expense.

If an individual, send P. O. Order and if not satisfied after 3 days, return same and we'll return your money.

International Metal & Specialty Co.,
24-28 Central Ave., Berlin, N. J., U. S. A.

FILL IN COUPON NOW! TODAY!

Name .....

Address .....

Construction Details That Make Friends for This Conveyor

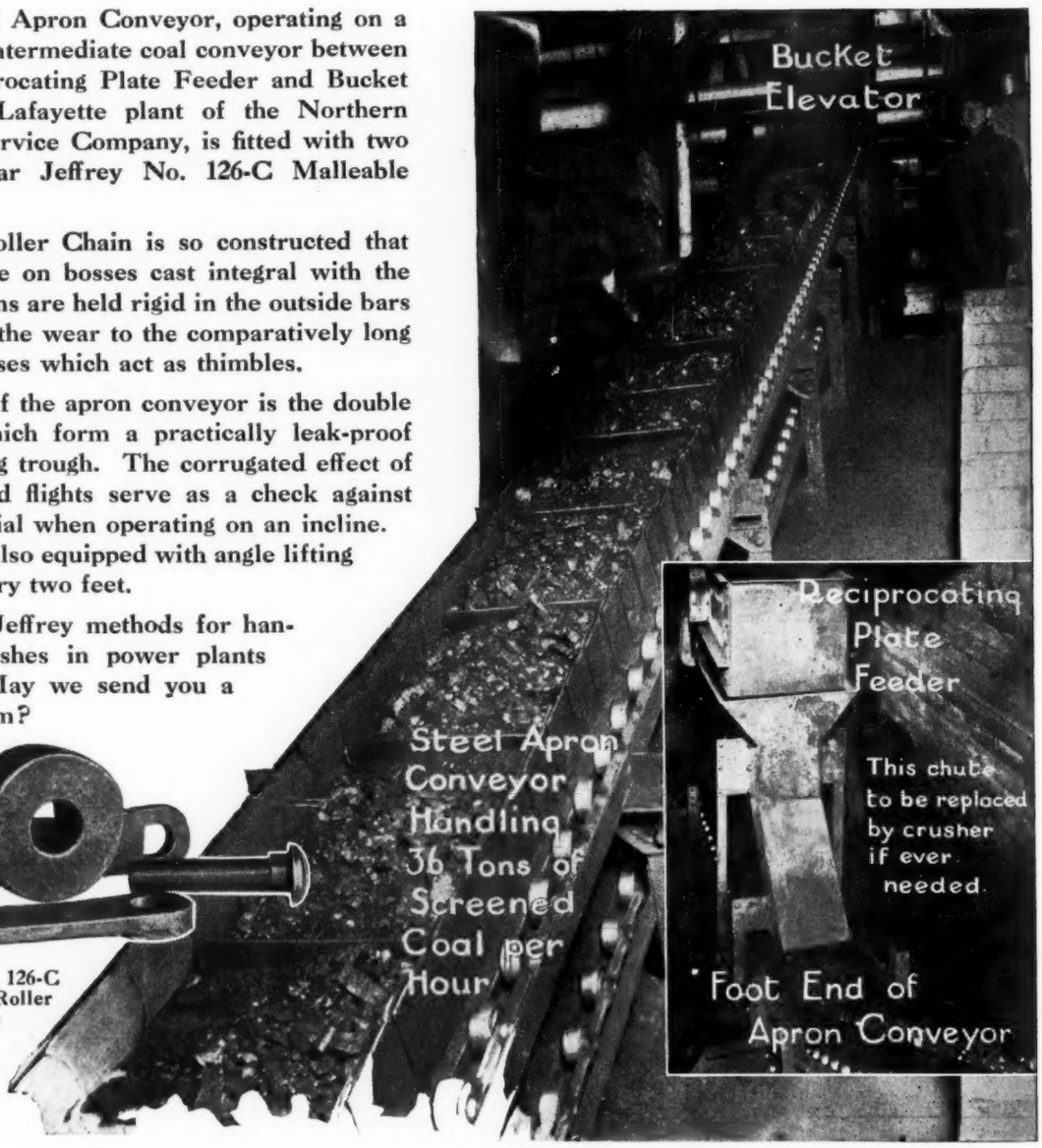
This Jeffrey Steel Apron Conveyor, operating on a 35° incline as an intermediate coal conveyor between the Jeffrey Reciprocating Plate Feeder and Bucket Elevator at the Lafayette plant of the Northern Indiana Public Service Company, is fitted with two strands of popular Jeffrey No. 126-C Malleable Roller Chain.

The Malleable Roller Chain is so constructed that the rollers revolve on bosses cast integral with the side bars. The pins are held rigid in the outside bars thus confining all the wear to the comparatively long surface of the bosses which act as thimbles.

Another feature of the apron conveyor is the double beaded flights which form a practically leak-proof continuous moving trough. The corrugated effect of the double beaded flights serve as a check against the flow of material when operating on an incline. This conveyor is also equipped with angle lifting blades spaced every two feet.

There are eight Jeffrey methods for handling coal and ashes in power plants of every size. May we send you a description of them?

Jeffrey No. 126-C Malleable Roller Chain


Bucket Elevator
Reciprocating Plate Feeder
This chute to be replaced by crusher if ever needed.
Steel Apron Conveyor Handling 36 Tons of Screened Coal per Hour
Foot End of Apron Conveyor

The Jeffrey Manufacturing Company

909-99 North Fourth St., Columbus, Ohio

New York, Buffalo, Rochester, N. Y., Philadelphia, Pittsburgh, Scranton, Pa., Boston, Cincinnati, Cleveland, Detroit, Chicago, Charleston, W. Va., Utica, Milwaukee, St. Louis, Denver, Salt Lake City, Atlanta, Birmingham, Houston, Montreal

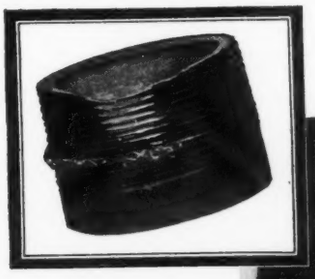
51 YEARS OF SERVICE TO INDUSTRY

JEFFREY

MATERIAL HANDLING EQUIPMENT

Jeffrey Products

Elevators—Conveyors
Portable Loaders
Coal and Ashes Handling Equipment
Skip Hoists
Chains and Attachments
Sprocket Wheels—Gears
Crushers—Pulverizers
Sand and Gravel Handling Washing and Screening Equipment
Locomotives
Coal Mine Equipment
Tipple Equipment
Ventilation Fans



Where pipe wears out—always at the ends—weakened by the threading and expansion-chamber action in the joint couplings.

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LEWIS-BROWN CO., INC.

DISTRICT OF COLUMBIA
WASHINGTON
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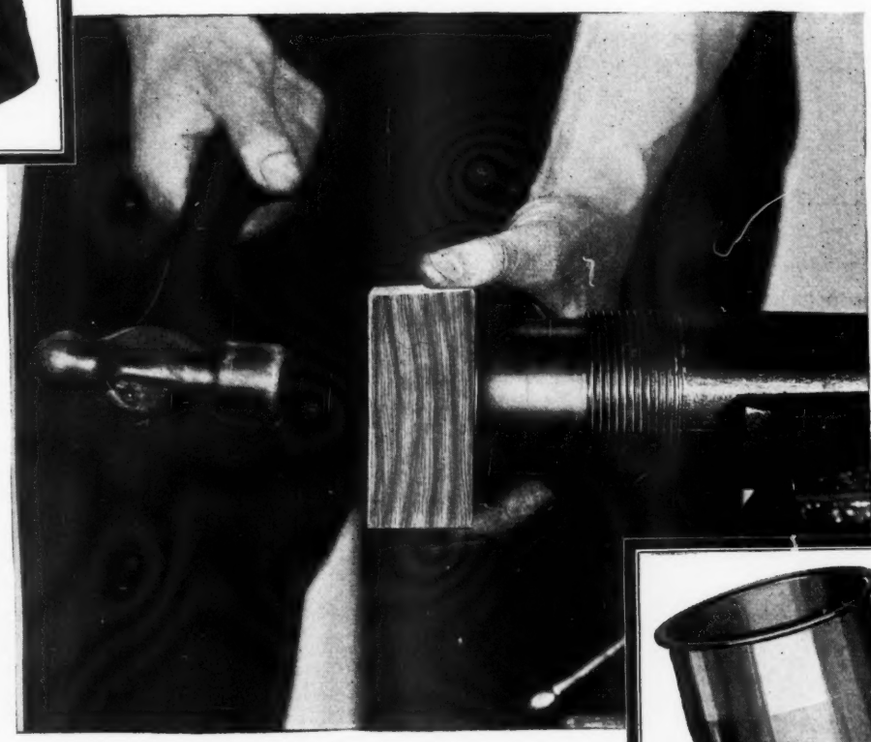
MILWAUKEE
RUNDLE-SPENCE MFG. CO.

After years of experimentation—

PIPE-SAVERS Are Now *READY* for You!



Above shows how easy it is to protect pipe against wear. After the pipe has been reamed ready for fitting, insert a PIPE-SAVER. Seat by striking with a block of wood held against the PIPE-SAVER flange. The flange threads into the fitting with the pipe. Photo at right shows a PIPE-SAVER as delivered, ready to install.

Pipe-Savers

At last—here is a device that protects pipe against the action of steam, water and acids

THIS device is simple and inexpensive but it positively does the trick. It is a piece of tubular metal, of an alloy that is practically impervious to the action of piped material, made in sizes to fit snugly into the ends of standard pipe. This reinforces the pipe where it has been weakened by threading.

Threaded pipe always wears out first at the ends, not only because the metal has been cut away and "cold worked" in threading but because special stresses come on the ends due to the expansion-chamber formed by the larger diameter of the joint coupling. Here the compressed contents of the pipe are suddenly expanded and then contracted, setting up a violent action that eats into steel or iron, causing leakage.

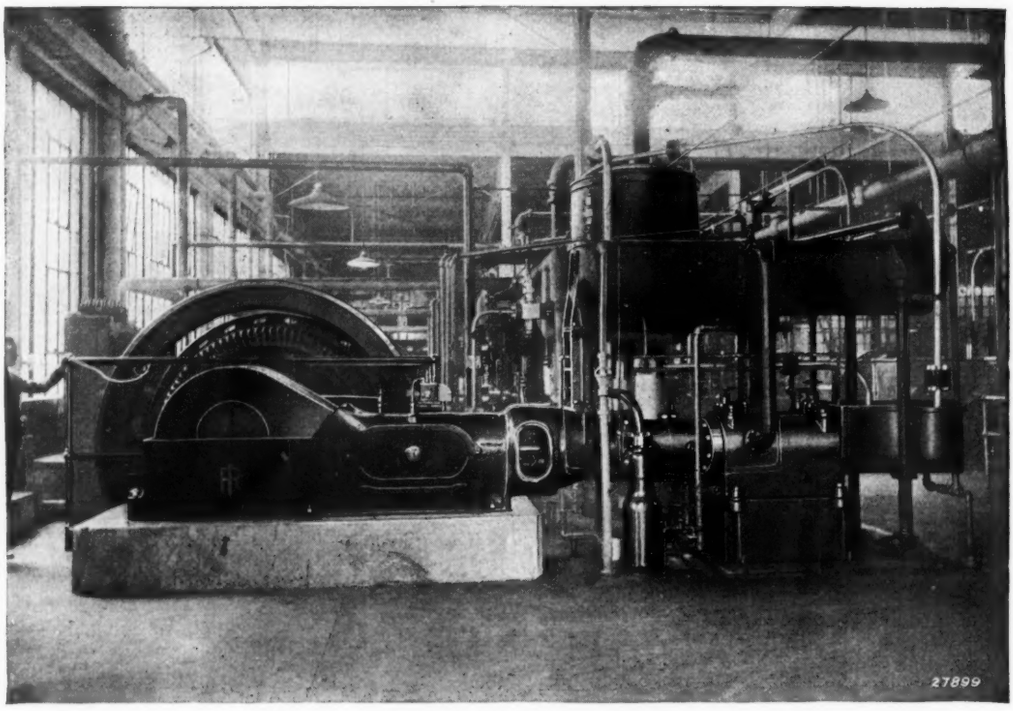
PIPE-SAVERS, by preventing leakage, will save large sums for you—in loss of pressure, of material, of shutting down, of labor, of new pipe, of damage to buildings. They also enable users of extra heavy pipe to buy the cheaper standard pipe instead.

In pipe that formerly wore out every few months, PIPE-SAVERS have resisted all apparent wear for three and a half years.

PIPE-SAVERS are for use in all new pipe as well as in replacement sections. Easily inserted, as shown above.

For samples and descriptive literature, phone the nearest distributor or address our Dept. 401.

PIPE-SAVER CORPORATION *of* AMERICA · CARTHAGE, N. Y.



PRE-6 Compressors Installed in the Ammonia Plant of The Mathieson Alkali Works (Inc.), Niagara Falls, N. Y.

4,500 Pounds Pressure

TEN TONS of synthetic anhydrous ammonia are produced daily at the plant of The Mathieson Alkali Works (Inc.), at Niagara Falls, N. Y. The process calls for the compression of nitrogen and hydrogen gases to a pressure of 4,500 pounds to the square inch.

Maximum efficiencies and economies of production require continuous operation. The burden of keeping these high-pressure gases flowing without break to the converter falls upon the compressors. They must function with precision and must also sustain their efficient performance 24 hours a day for months at a time.

The Mathieson plant is served by three Ingersoll-Rand 6-stage compressors. They were made on special order and are the only American-built 6-stage compressors in service today. They have proved their dependability and efficiency over a period of 3 years of satisfactory performance.

It is significant to note that the same principles of design and construction that successfully meet such exacting service conditions are embodied in the standard PRE compressors which are in widespread use throughout the world.

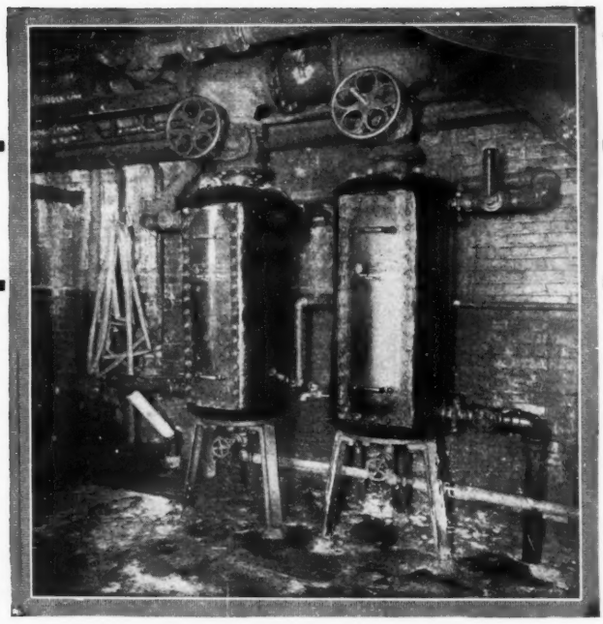
INGERSOLL-RAND COMPANY • 11 BROADWAY, NEW YORK CITY

Offices in principal cities the world over

For Canada Refer—Canadian Ingersoll-Rand Co., Limited, 10 Phillips Square, Montreal, Quebec

914-C

Ingersoll-Rand



Reilly Water Heaters serving over 12,000,000 B.H.P.

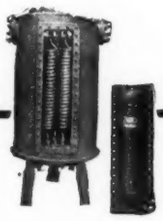
Reilly Heaters on water-heating service for large milk company

Clean, hot water—
instantly and economically

Exhaust steam passed through a Reilly Heater will quickly and efficiently heat water for boiler feeding, process work, or any other purpose.

As the steam does not come into contact with the water to be heated, any source of dirty or oily exhaust or low pressure steam can safely be used without contaminating the water. The patent crimped coils constantly break up the stream of water passing through the heater, providing an exceptionally high rate of heat transfer, and the heater will take care of heavy overloads with only a slight decrease in the final water temperature.

On boiler feed service alone, the Reilly Heater is installed in over 12,000,000 boiler horsepower, and it is also widely popular in every other type of industrial and domestic service as well.



Note these features of the Reilly Water Heater

- Design assures high rate of heat transfer.
- Spring-like coils take up all expansion strains.
- Extremely simple and compact—all parts accessible.
- No expanded or brazed joints.
- Nothing to wear out or get out of order.

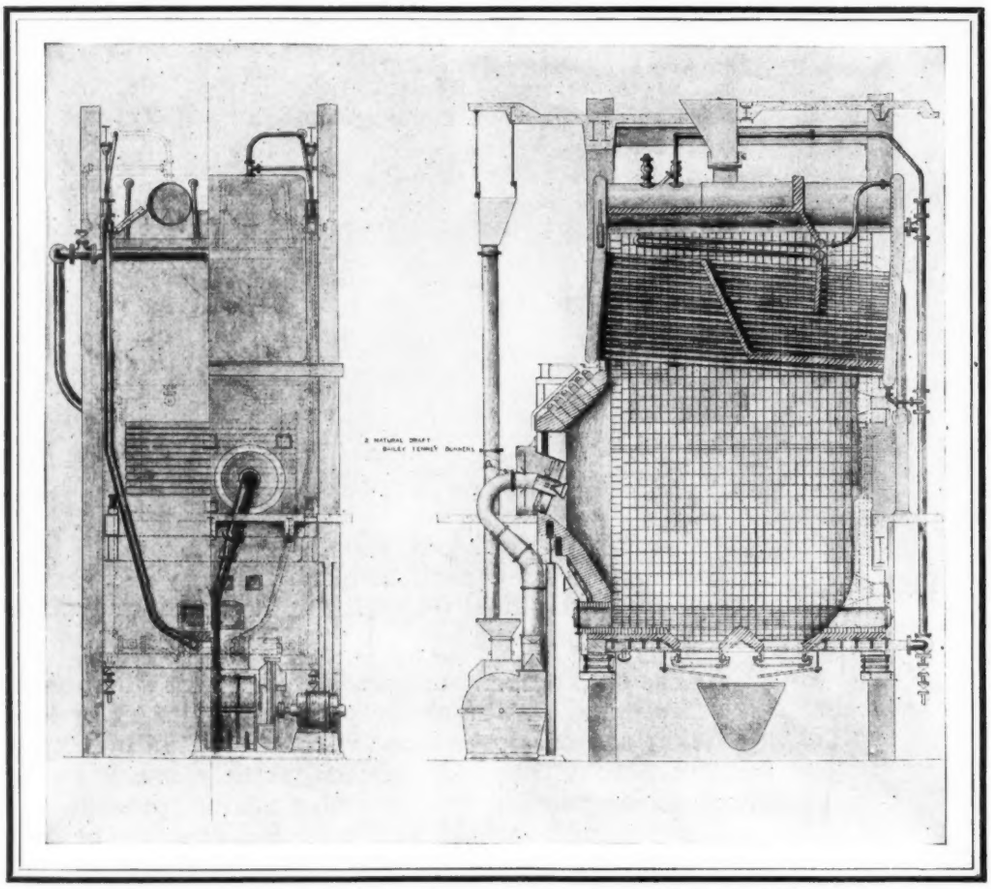
The Griscom-Russell Co., 285 Madison Ave., New York

Philadelphia	Indianapolis		Kansas City	Atlanta
Boston	Chicago		St. Louis	San Francisco
Rochester	Cleveland		New Orleans	Los Angeles
Pittsburgh	Detroit		Houston	Denver
Massillon	Milwaukee		Dallas	Seattle
Columbus	Minneapolis		Charlotte	Tulsa

For Canada: Riley Engineering & Supply Co., Ltd., Toronto

Griscom-Russell
Transfer Heat Apparatus

Capacities of Old Stoker-Fired Boilers at Ashley Street Increased from 235% to 330%



Transverse and longitudinal sections of one of the 24 boilers at Ashley Street, equipped with Bailey Walls and Bailey-Tenney Pulverized-Coal Burners.

Twenty-four boilers at the Ashley Street Station of the Union Electric Light & Power Company, St. Louis, Missouri, which were formerly stoker-fired, have been equipped with Bailey Water-Cooled Furnace Walls and Bailey-Tenney Pulverized-Coal Burners.

As a result of this change, the capacities of the boilers have been increased from 235 per cent to 330 per cent of maximum rating with occasional peaks of 400 per cent. Economy of operation has also been improved.

The satisfactory performance of these boilers in the Ashley Street Station led to two boilers in the 1927 Cahokia Station Extension, being equipped with Bailey Furnace Walls and three boilers with Bailey-Tenney Forced Draft Burners.

Operating Data

	Ashley Street	Cahokia
Boiler Heating Surface, sq.ft.	5,580	18,010
Boiler Rating in per cent....	330	400
Coal-Pulverizing Capacity in lb. per hr.	8,000	30,000
B.t.u. liberated per cu.ft. of Furnace Volume per hr. ..	25,000	24,200

FULLER LEHIGH COMPANY

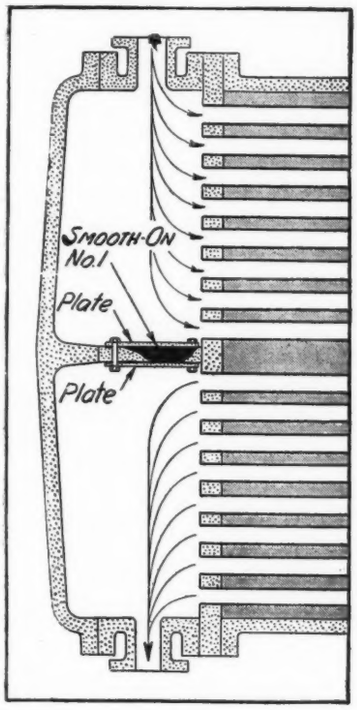
[A Babcock & Wilcox Organization]

FULLERTON----PENNSYLVANIA

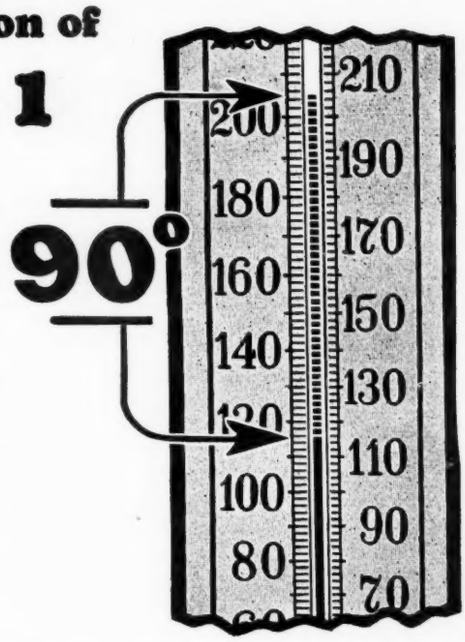
Note rise in feed-water temperature

A 7% fuel saving from an application of

SMOOTH-ON No. 1



THE delivery temperature from a large closed heater in the power plant of a Massachusetts woolen mill gradually dropped until water was entering the boilers at lower than 115 deg. This heater was of the type in which water flows one way through half of the tubes and back through the other half. Dismantling and internal inspection showed that holes had been worn into the baffle in the water box end and the travel of much of the water was short-circuited.



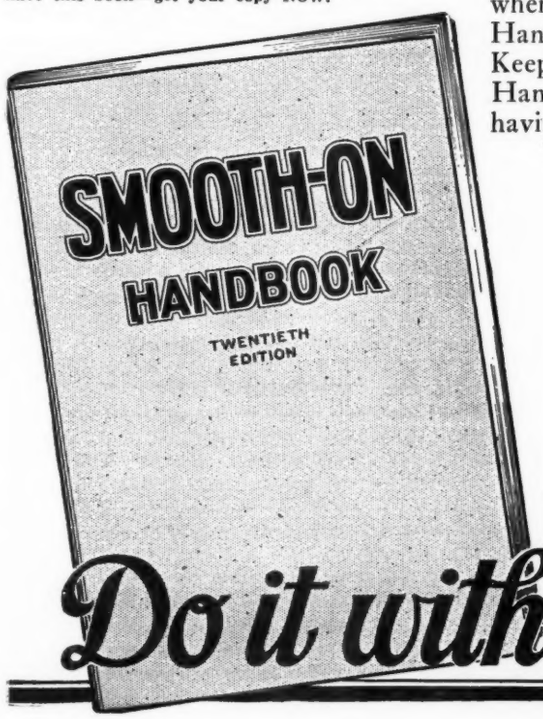
The worn spots and holes were built up with about 25 lb. of SMOOTH-ON No. 1 which was permanently held in place with plates as shown in the sketch. After letting the SMOOTH-ON harden thoroughly the head was put back on and the delivery temperature was restored to over 200 deg. Four years later this heater was still operating with the same perfect heating effect.

As every 11-deg. increase in feed-water temperature saves one per cent of the fuel, this immediate return paid handsomely for the SMOOTH-ON repair, which cost only a small fraction of what would otherwise have been spent for a new water box.

SMOOTH-ON No. 1 invariably saves time, labor and material expense in making repairs at leaky joints, seams and cracks, and when used in accordance with instructions in the SMOOTH-ON Handbook, the results are dependable, safe and permanent. Keep SMOOTH-ON No. 1 in your storeroom, and the SMOOTH-ON Handbook on your desk. Some day you will be thankful for having taken this precaution.

THE SMOOTH-ON HANDBOOK FREE if you return the coupon

Twentieth Edition — Completely rewritten — 136 pages of new data—193 diagrams, pictures and practical hints on at least 200 different uses for SMOOTH-ON. Every progressive engineer should have this book—get your copy NOW.



Get the Handbook free by mailing the coupon, and get a 1 or 5-lb. can or 25, 50 or 100-lb. keg of SMOOTH-ON *No. 1 from your nearest dealer or if necessary from us direct.*

SMOOTH-ON MFG. CO.,
Dept. 30, 570 Communipaw Ave., Jersey City, N. J.

Please send copy of the SMOOTH-ON Handbook, 20th Edition.

Name .....

Address .....

.....

6-26-28

Do it with SMOOTH-ON

ORGANIZATION
FOR ANY PROJECT

IF you are planning a new development in any field of enterprise we are prepared to help you ORGANIZE it.

We can provide engineers to make investigations, reports or appraisals preliminary to financing.

We can provide financial plans and assist in financing.

We can provide complete designs and the construction personnel to carry out work of any type or magnitude.

PIONEERS SINCE 1889

Stone & Webster, Inc., is the oldest firm in the power industry. Its organization for design and construction is large, widely experienced and extremely flexible. It can design, purchase for and build developments of any size or kind. It has made many records for speed. The power stations built serve 20,000,000 people. In utilities work over $100,000,000 is expended annually.

Industrial work for such companies as Ford, General Motors, American Sugar, U. S. Rubber, Victor and others is measured high in millions and for many clients has been continuous for years. Experience also includes construction of large buildings for such clients as The Insurance Company of North America, University of Pittsburgh, The First National Bank of Boston and others.

Hundreds of reports have been made covering financial requirements, physical condition, operating costs, inventories, plant extensions, earning power and other features. Properties to the value of $6,000,000,000 have been appraised.

As executive managers, Stone & Webster handle the operation, engineering, purchasing, construction and financial requirements of sixty separate public utility and industrial companies. Recently the Coffin Award, the highest in the gift of the street railway industry, was won by a Stone & Webster company.

STONE & WEBSTER
INCORPORATED

No Scale and No Corrosion at Syracuse

SYRACUSE University, having outgrown its original heating system, has installed, through one of the best engineers in the country, a modern district heating system. During the past year the new installation, including an extensive underground system of mains and two 600-hp. Connelly Boilers, fitted with Foster superheaters, designed to operate at 300% of rated capacity and carrying 200 lbs. pressure, has been placed in operation.

In order to prevent boiler scale the feed water from the city mains is treated in a COCHRANE HOT PROCESS SOFTENER, of 8,000 gal. per hour capacity. The heater part of the softener is of the Cochrane Deaerating type, with two compartments, one for the raw water, which is subsequently treated chemically in the reaction chamber of the softener, and the other for the condensed returns from the heating system, which pass directly from the Deaerator to the feed pumps. After having been heated, treated and settled, the make-up passes through a Cochrane Non-Silite Filter.

For cleaning the softener and backwashing the filter, water is drawn from the softener and returned, together with the suspended matter removed from the filter, to the sedimentation chamber, the sludge being discharged from the conical bottom of the latter in the usual manner. This not only avoids chilling the filter, as where cold unsoftened water is used, but no heat or water is wasted. The boilers are free from scale and sludge and are blown down only when the concentration of soluble salts becomes too high.

If you are interested in conditioning boiler feed water, ask for Cochrane Bulletin L-670, or if in Deaerators to prevent corrosion, for Bulletins L-672 and L-675.

COCHRANE CORPORATION

17th and Clearfield Streets, Philadelphia, Pa.

441

"Beyond Their Horizon" George Edwards—Engineer

"I've run into an interesting state of affairs in my plant that I want to tell you about. It happened as a result of my going after an appropriation to install some equipment that ran into fairly large figures.

"The idea for making the installation originated in these ads. I thought the whole thing out, made up an appropriation request with all of the engineering data on heat units and overall efficiency and increased capacity that I could muster together. When the board of directors went over the report they frowned a bit, tried to look as though they understood the formulae I had included —and turned the request down flat.

"Yes, I felt pretty badly for I knew beyond a doubt that this equipment I wanted would cut our production costs. The interesting thing that I found on going over my rejected report was that there were so many technical figures, they had buried the data on savings to be made so even I had a hard time to find them.

"What had I done? Simply failed to realize that I had a sale to make to that board, a sale of the equipment I wanted in terms that would interest the board. Such terms have very little to do with technical aspects and a great deal to do with dollars and cents from or into the company's safe.

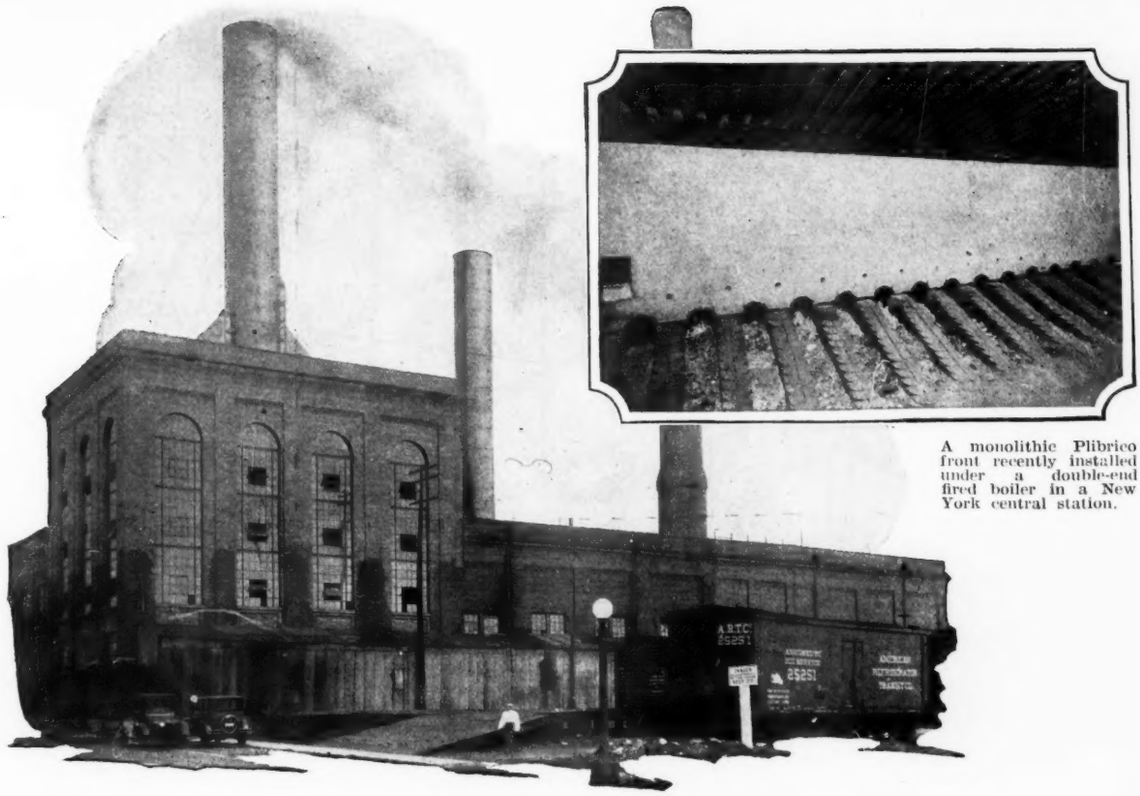
"And what did I do? Nothing to speak of except to rewrite the report cutting out most of the technical reference and bringing out the practical results to be gained in terms financial. Then I presented the request at the next meeting. Yes, it went through with flying colors.

"The point is that these ads provide the engineer with an idea for bettering conditions in terms of less heat loss or better control or longer life without mishap. The engineer starting from there must convert these engineering savings into terms that the average money minded board of directors can understand. If this conversion results in optimistic figures the rest of the way to the granted appropriation is fairly clear sailing.

"Let me illustrate with an ad or two, starting with this one that says 'Control the feed of coal . . . equipment will work better.' Now most directors do not know what a coal feeder is and, reading from the ad, 'spillage, undue sagging, belt strain, choked crushers, filled elevator boots' is mostly beyond their horizon.

"But stop a minute and convert all of these potential breakdowns into dollars of lost production, higher power costs, larger maintenance payroll, shorter life of equipment. Then stack the cost of the feeder, that this advertiser will recommend for your particular plant, against these losses and your request for the needed appropriation is almost certain to pass the board.

"Of course, it's unnecessary to request appropriation for everything you buy or want to buy. There are many little items. This inexpensive sound device in this issue for locating hidden troubles is such an item. But you can nevertheless apply the dollar savings cost for your own benefit and often to better effect."



A monolithic Plibrico front recently installed under a double-end fired boiler in a New York central station.

Firebrick: 120 days–Plibrico: 1 year

IN THIS Illinois central station there are two 900 hp. Springfield boilers, with chain grate stokers, which operate at 225% of rating. Under these boilers, joint-weakened firebrick never lasted longer than 120 days of operation. Complete Plibrico linings had given a year's continuous service when this photo was taken.

Four 500 hp. boilers at this plant also have complete Plibrico linings.

* * *

Plibrico is firebrick in plastic, putty-like form. It is installed chunk-by-chunk with a mallet, and is then baked out by the first heat of the fire to give a jointless, one-piece lining resistant to 3100 deg. F.

Because Plibrico gives a lining like a lining carved out of a single brick, *it outlasts laid-up firebrick 2 to 4 times!*

Try Plibrico for your next repair or new setting. Send the coupon for your copy of "Cutting Furnace Costs"—36 pages. There are warehouse stocks and engineers in over 90 cities, and our local engineers teach your men to install Plibrico, or can furnish a labor crew.

Nation-wide boiler setting service

But don't accept a substitute for *genuine* Plibrico. Plibrico is a pioneer plastic, tried and proved by over 20,000 users.

PLIBRICO *furnace lining*

REG. U.S. PATENT OFFICE

—the superior plastic

☐ **Send the 36-page book — *FREE***

Repairs needed about? _____

What repairs necessary? _____

Firm _____

Address _____

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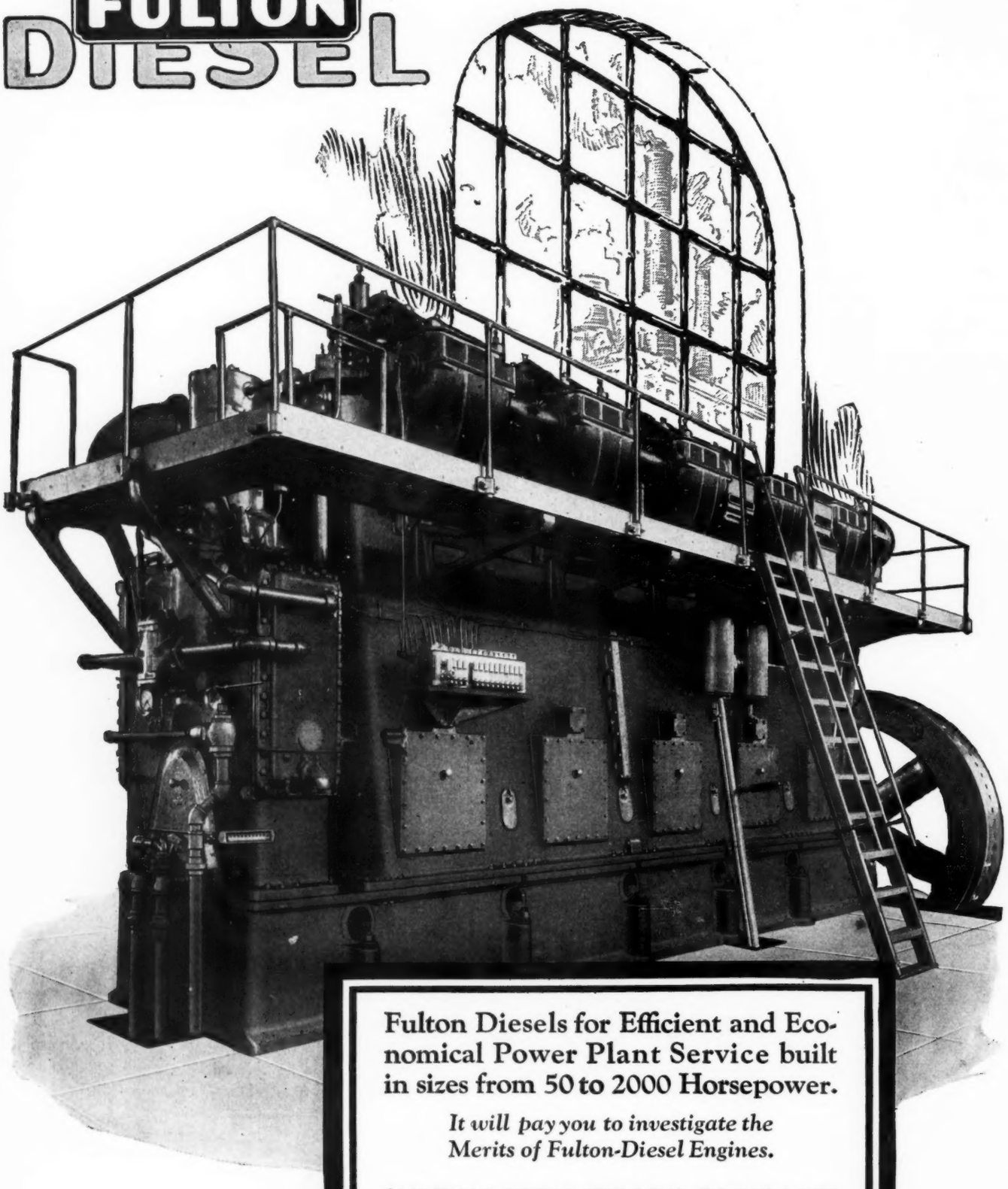
Att'n _____ *Title* _____

Mail to PLIBRICO JOINTLESS FIREBRICK CO.
1844 Kingsbury Street, Chicago P-6-26-28

FULTON DIESEL



Fulton Diesels for Efficient and Economical Power Plant Service built in sizes from 50 to 2000 Horsepower.

It will pay you to investigate the Merits of Fulton-Diesel Engines.

FULTON IRON WORKS COMPANY
ST. LOUIS, U. S. A.

BRANCH OFFICES and AGENTS: New York • Dallas
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The Doctor Claims I'm Crazy! — Last June I said that Baffle Walls should be — *FLEXIBLE* He admits I was sane then. ①

In October I said that no metal *should be used* in baffles because metal always *REINFORCES* "That's where your insanity began" — says the Doctor ②

In January — I advocated absolutely solid walls, reinforced with metal - A guy has a right to *ADVOCATE* things, hasn't he? You see, science has made great strides ③

Now - I am in favor of a soft *FLEXIBLE* "mystery" material that will come and go with the tubes as they expand and contract, like an accordion - It's a wonderful idea - folks! ④

What Do You think? Am I COO-COO? Huh? ⑤

None of this crazy stuff for us

3,000,000 boiler hp. of Turner Boiler Baffles are *proving*, every day, what the Turner can do. The TURNER is a *truly* flexible wall. It is NOT monolithic. It is NOT reinforced. 13 years of unparalleled success, saving 405,000 tons of fuel annually.

The BECO Baffle is the Turner's direct offspring. In principle it is precisely the same. NOT monolithic. Not reinforced. Positive expansion joints. Cracking and breaking are impossible.

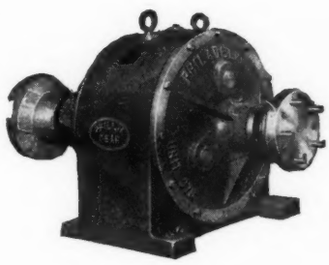
We build both the Turner and the BECO. Applicable to all makes and types of water tube boilers—horizontal and vertical.

Send sketches and let us tell you what a real baffle wall will do for your boilers and what it will cost.

Boiler Engineering Co.
931 Federal Trust Bldg.
Newark, N. J.

Philadelphia
SPEED REDUCING UNITS

mean practically no loss between "applied" and "delivered" POWER



Spur Gear Reducer
Type M-2

PHILADELPHIA SPEED REDUCERS consistently deliver a "high per-cent" of the applied power,—because every precaution is taken to reduce frictional losses, and to assure accurate tooth contact of Gears. Ball and Roller Bearings (or both) are used on shafts, as the service requires,—while all moving parts operate in an "oil bath." All Gears and shafts are made of the highest grade metals, accurately machined, and properly heat treated for resistance to wear.

Available in every type. This assures the purchaser of the "best type" to suit particular requirements.

The result of nearly a half century of Gear Making Experience.

Our Engineers will be glad to help you with your Speed Reduction Problems.

Main Office and Plant Erie Ave. and G St. Phila., Pa.

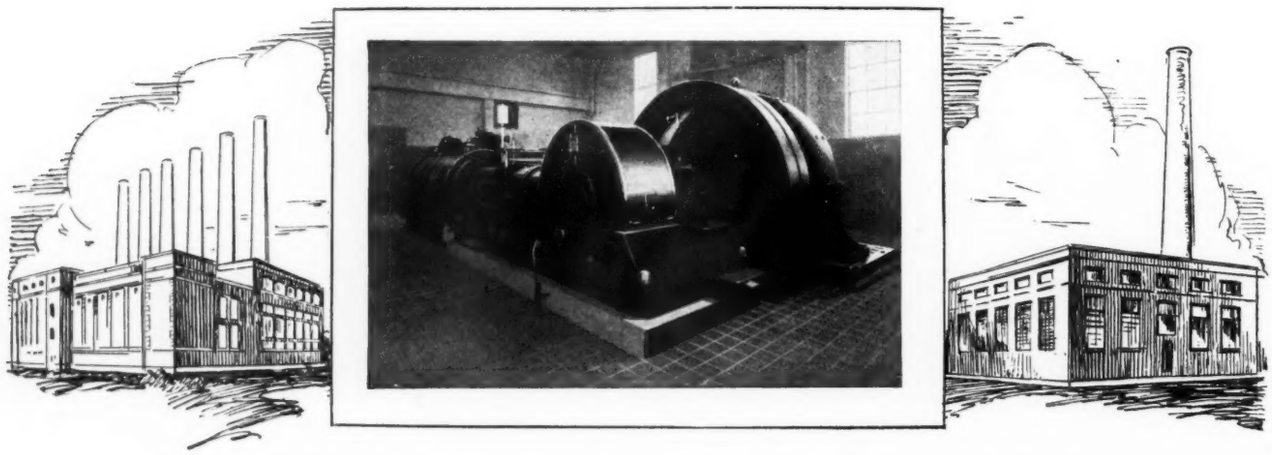
PHILADELPHIA GEAR WORKS

Manufacturers of Industrial Gears and Speed Reducing Units

PHILADELPHIA, PENNA.

Branch Sales and Engineering Office: 12 E. 41st St., New York

Privately Owned
POWER PLANT
makes owners 110% yearly on their cash investment



A new manufacturing plant was being erected on property adjacent to a large sub-station of a public utility plant. On the estimated load they could buy current for 1.89 cent a kilowatt-hour.

From our experience gained in installing "Universal Unaflow" engines in hundreds of manufacturing plants, the heating requirements could be closely estimated and, although the central station people insisted that the equipment would lose thousands of dollars a year, we agreed to install an engine with generator under the Skinner Guaranteed Saving Contract, costing $29,761.00, and to take the entire amount in the savings effected.

PURCHASERS' INVESTMENT LESS THAN.....$14,000.00
This included foundations, switchboard, erection, steam and electrical connections.

YEARLY EARNINGS.....$15,600.00
The first few months' operation has convinced the purchasers that the estimated saving of $1300.00 a month is being obtained.

SAVING IN TEN YEARS.....$129,000.00
or more than three times the cost of the plant, plus the plant, on the basis that money saved can earn 6%, and the plant would still be there, good for years of continual service.

If they had purchased central station current, they would have spent this money and all they would have to show for it would be three wires leading into their building and—another bill.

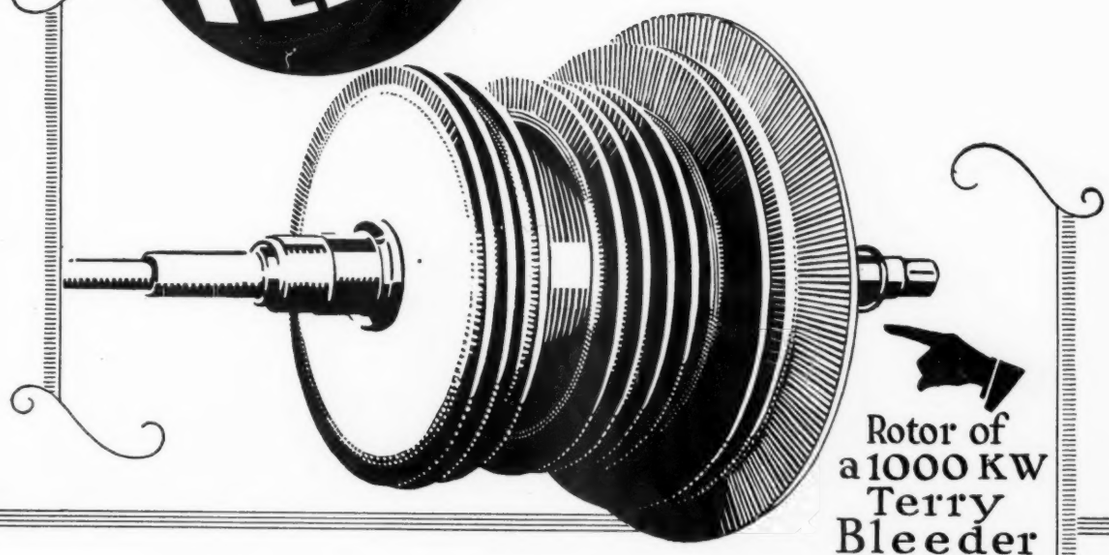
This, and many other cases we can cite, proves that in many manufacturing plants a greater percentage of profits on the amount invested can be made by the installation of a "Universal Unaflow" engine than from any other department of the business.

Write for our 32-page illustrated booklet which gives the savings other power users have effected under the Skinner Guaranteed Saving Contract, which provides for our furnishing the equipment with our own money and taking our pay in the savings effected, and then perhaps you will let us survey your power conditions without any expense or obligation on your part.

SKINNER ENGINE COMPANY—Erie, Penna.

Branch Offices in All Principal Cities.

TERRY



Rotor of a 1000 KW Terry Bleeder Turbine

Multi-Stage Turbines up to 2000 H.P.

—Terry multi-stage turbines are the result of over thirty years' successful experience.

—They are used the country over for driving generators, alternators, pumps, blowers, centrifugal compressors, etc.

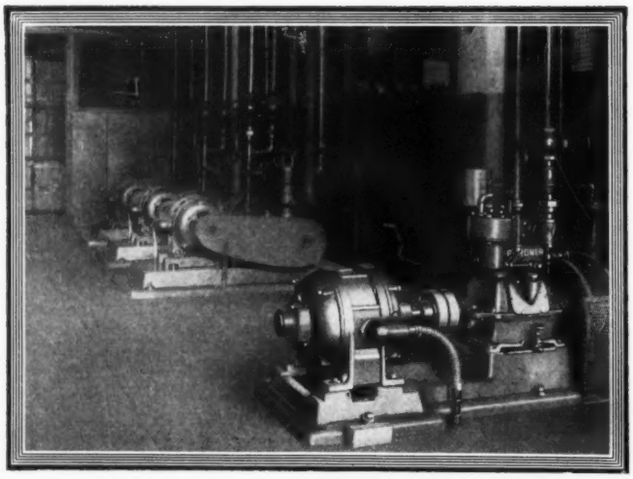
—And they are built for condensing, non-condensing, mixed pressure or bleeder operation.

—Terry engineers will gladly discuss their application to meet your requirements.

The Terry Steam Turbine Company

TERRY SQUARE, HARTFORD, CT.
OFFICES IN PRINCIPAL CITIES
Steam Turbines + Gears + Shaft Couplings

T-1011



[Installed in the Chicago Plant of the Continental Can Company.]

Continued Satisfaction

Continued satisfaction throughout the years is well exemplified in the above photograph. In the background is a Gardner-Rix Compressor installed many years ago. The next two are Gardner Type XH Chain Driven Compressors which were installed in 1925. In the foreground is the latest type Gardner Direct Connected Compressor installed in 1927. The continued preference for Gardner-Denver Compressors is a silent testimonial to a record of satisfactory performance throughout the years. Write for bulletin and price on a compressor suitable for your immediate requirements.

GARDNER-DENVER COMPANY
QUINCY, ILL. DENVER, COLO.
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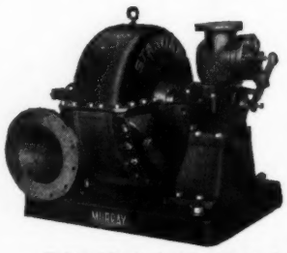
GARDNER DENVER

TURBINES



BOILERS
UNI-FLOW ENGINES
CORLISS ENGINES
TURBINES
GENERATOR UNITS
WATER WORKS PUMPS

MURRAY IRON WORKS CO.
INC. 1870
BURLINGTON, IOWA

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Steam Turbine Co., Trenton, N.J.

Manufacturers of Steam Turbines, Centrifugal Pumps, Centrifugal Blowers and Compressors, Flexible Couplings, Double Helical Speed Reducing Gears, Worm Gears, Hydraulic Turbines and Special Centrifugal Machinery.

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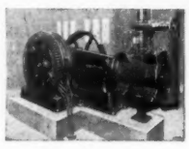

PENNSYLVANIA

Single stage, direct connected Air Compressors
Bulletin No. 127
Pennsylvania Pump & Compressor Co.
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Steam Turbines
Centrifugal Pumps
Moore Steam Turbine Corporation
Wellsville, N.Y.
"Best at Every Turn"

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are designed and built for heavy duty in driving stokers, fans, pumps and generators. Entirely enclosed. Automatic lubrication. Capacities to 200 brake horsepower. Write for catalog.

Only Steam Engines Good Engines Only

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Natural Gas and Blast Furnace Gas Burners
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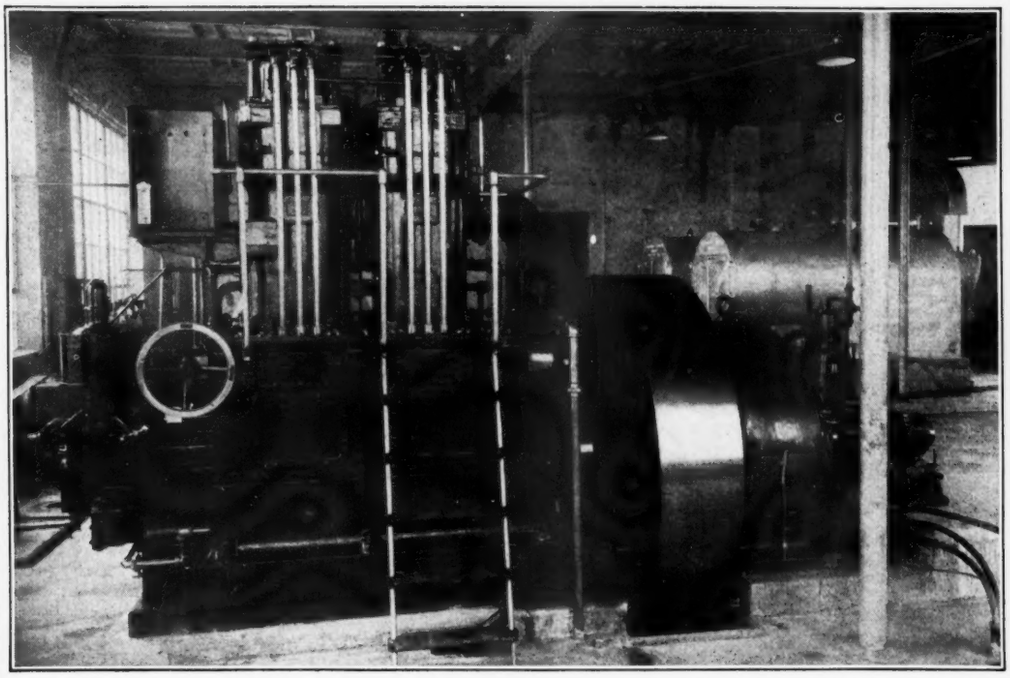
ECONOMICAL OPERATION—LOW UPKEEP COST—LONG SERVICE LIFE



Another Installation of Low Cost, Dependable Power

The 2 cylinder Superior-Otto Diesel Engine shown above, is furnishing power for one of the largest and most well-known Dairies in the East. Needless to say, the owners are more than pleased with its performance.

SUPERIOR-OTTO DIESELS due to their features of design are of necessity Low in Fuel Oil and Lubricating Oil Consumption,—and in addition, they are so ruggedly yet accurately built that their Maintenance Cost is practically nil over extremely long Service Periods.

SUPERIOR-OTTO DIESELS are the result of a combined Internal Combustion Engine Experience of nearly 100 years and are built in "one of the largest" and most complete oil engine plants in America.

To substantiate our claims for Superior-Otto Economy and Efficiency, we will gladly send you a copy of our Non-Technical Booklet "B." This Booklet not only shows Otto Engines at work in various industrial plants, but tells how they are cutting power costs wherever installed. (Please use your Business Letterhead when writing for this Booklet).

THE OTTO ENGINE WORKS

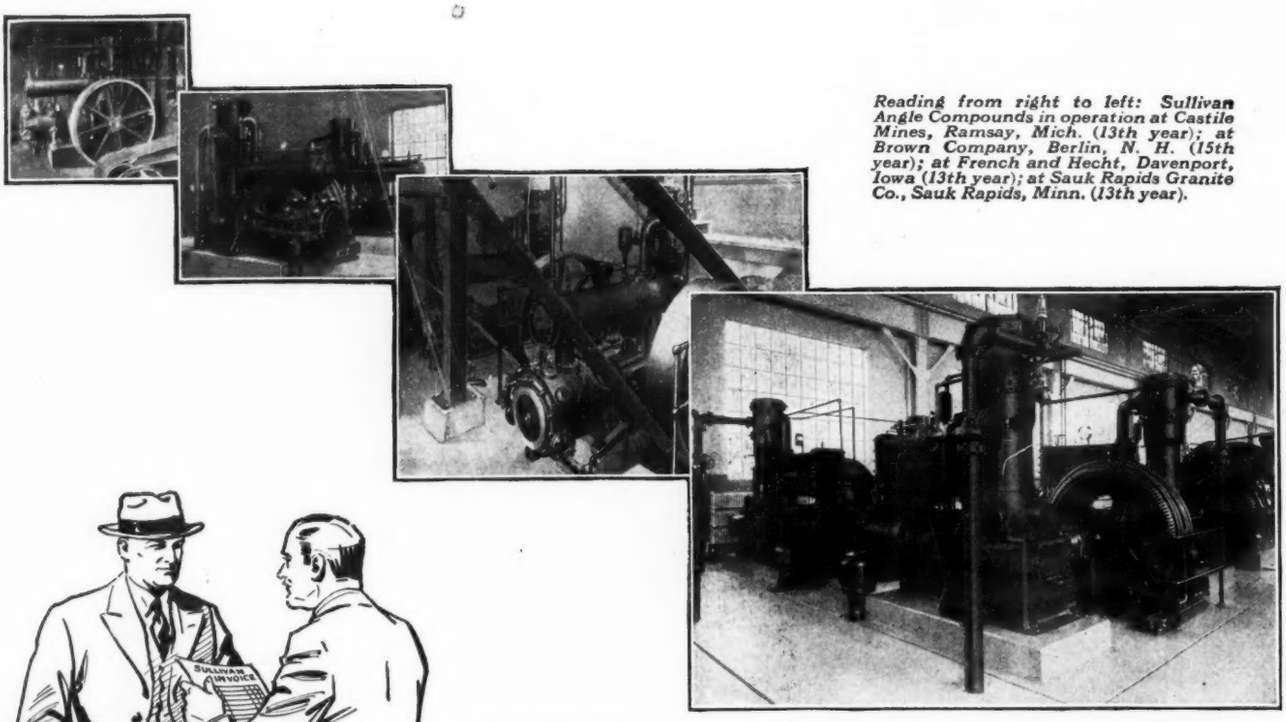
Rhawn St. and State Road, Philadelphia

Division of Superior Gas Engine Co., Springfield, O.

DIESEL

SUPERIOR-OTTO

ENGINE



Reading from right to left: **Sullivan** *Angle Compounds in operation at Castile Mines, Ramsay, Mich. (13th year); at Brown Company, Berlin, N. H. (15th year); at French and Hecht, Davenport, Iowa (13th year); at Sauk Rapids Granite Co., Sauk Rapids, Minn. (13th year).*

"How Long Do Angle Compounds Last?"

(Number 3 of a Series)

Synopsis of "Riley and Brown"

Superintendent Riley recommended the purchase of an Angle Compound Compressor. General Manager Brown agreed and the machine was installed. The management noticed an immediate reduction in power bills, which Riley explained was due to "multi-step" load control. Now they are deciding how to write off the cost of the Angle Compound.

"Say, Riley, the cost department wants to know how to charge off our new Angle Compound Compressor. How long can we expect economical service from Angle Compounds?"

"How long? I can't tell you, Mr. Brown. You see, Angle Compounds have only been in use fifteen years—not long enough to wear one out.

"Last week, when I went down to the Brown Company at Berlin, New Hampshire, I saw two Angle Compounds installed fifteen years ago, running along with three others that have been installed since.

"And at the Castile Mines, French and Hecht, Sauk Rapids Granite Company, and scores of other places, Angle Compounds have been running for more than twelve years."

"But, Riley, how can these compressors still supply air power as economically as equipment ten or fifteen years newer? Isn't that unusual?"

"Sure it's unusual—but so are Angle Compounds. They've kept step with modern improvements in detail, of course, but in fifteen years no other compressor design has been developed so economical from every standpoint as Balanced Angle Design."

Long, efficient service is only one of the Angle Compound economy features. Others are described in Catalog 83-J. *Use the coupon to get it.*

BALANCED ANGLE COMPOUND
SULLIVAN

For Lowest Possible Cost Per Unit of Air Compressed

SULLIVAN TRADE MARK

SULLIVAN MACHINERY COMPANY
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Send me Free Catalog 283-F, describing Sullivan Vibrationless Compressors
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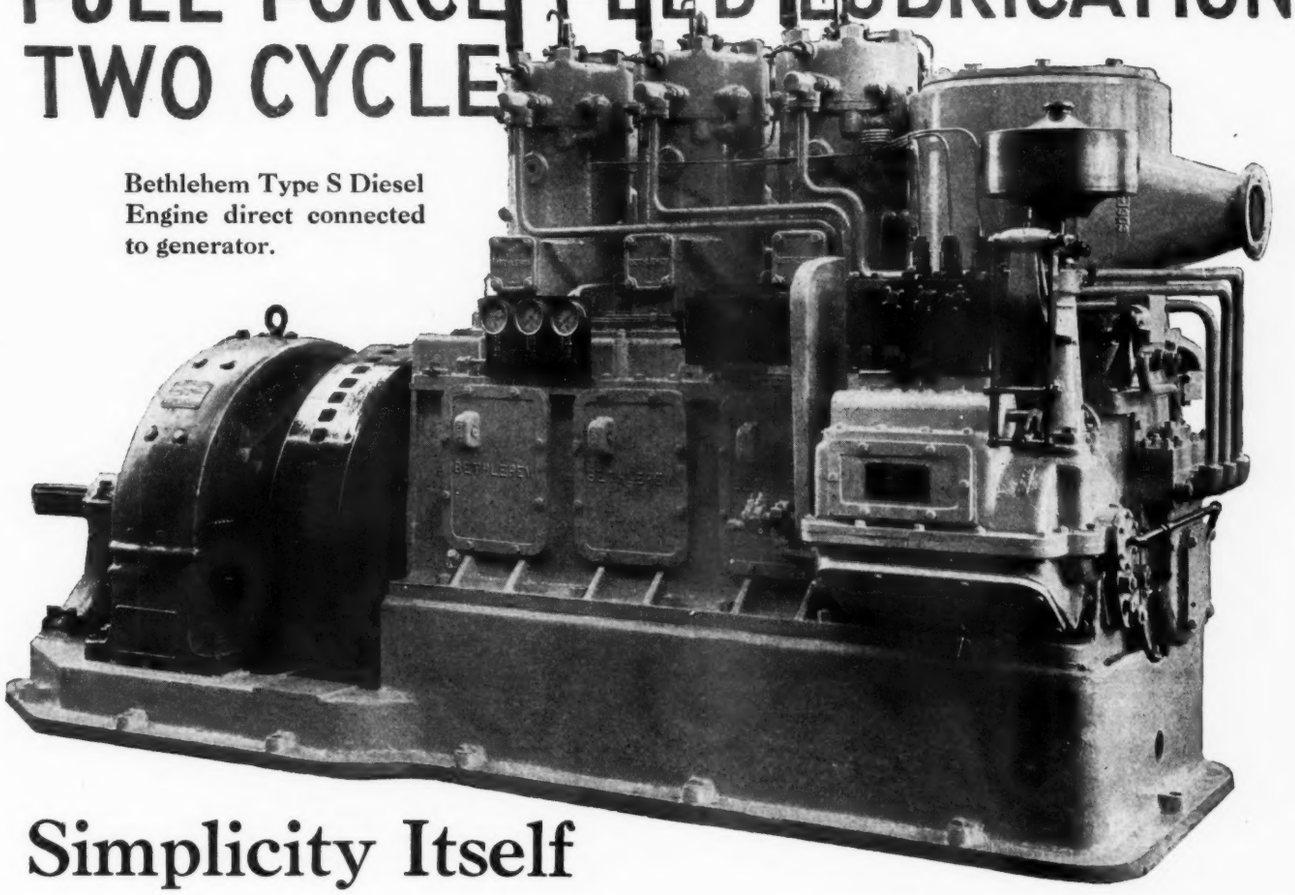
Sullivan Machinery Company, 132 So. Michigan Ave., Chicago

SOLID FUEL INJECTION
BUILT-IN SCAVENGING PUMP
FULL FORCE FEED LUBRICATION
TWO CYCLE



Bethlehem Type S Diesel Engine direct connected to generator.

Simplicity Itself

Both in its construction and operation the Bethlehem Diesel is simplicity itself.

The use of the solid (Leissner) system of fuel injection eliminates cam shafts, rocker arms and mechanically-operated fuel valves. The built-in scavenging pump eliminates exhaust valves and separate equipment for scavenging air, and at the same time supplies an abundance of fresh air for efficient scavenging and complete combustion.

Even an untrained attendant can be entrusted with the handling of a Bethlehem Diesel Engine, for its simplicity assures ease of operation.

Take the starting of the Engine, as an example. A master valve controls the starting air pressure, and when the temperature in the cylinders has reached the combustion point a master fuel valve admits oil to the cylinders and the air is shut off. Regulation of speed and other details of handling are equally simple.

Bethlehem Engineers will gladly confer with you regarding your power problems.

BETHLEHEM STEEL COMPANY,
General Offices: BETHLEHEM, PA.

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BETHLEHEM
DIESEL ENGINES

IMPORTANT BRIDGES IMPERATIVELY MUST OPERATE

The Kennebec River bridge at Bath, Me.; Point Street bridge at Providence; D. L. & W. bridges at Hackensack; C. R. R. of N. J., bridges over Newark Bay, and 20 Welland Canal bridges and others are equipped with

Sterling
High Duty
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Engines

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Special applications for bridges.
12 to 565 B. H. P., 600 to 1500 R. P. M

STERLING ENGINE COMPANY, Dept. C-1, Buffalo, N. Y., U. S. A.

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85 LIBERTY STREET, NEW YORK

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Makers of Steam Superheaters since 1898 and of Chain Grate Stokers since 1893

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The Casey-Hedges SEMI-VERTICAL *Water Tube* BOILER

Made in sizes to 2500 hp. and pressures to 450 lbs.

Write for Catalogue S-V-3

The Casey-Hedges Co.
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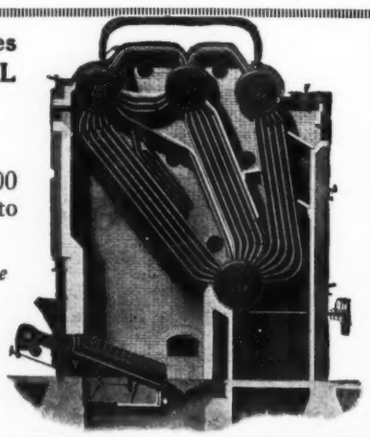

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Pressures up to 500 lb. Large Size Units
Our Headers Are Seamless
The Walsh & Weidner Boiler Co.
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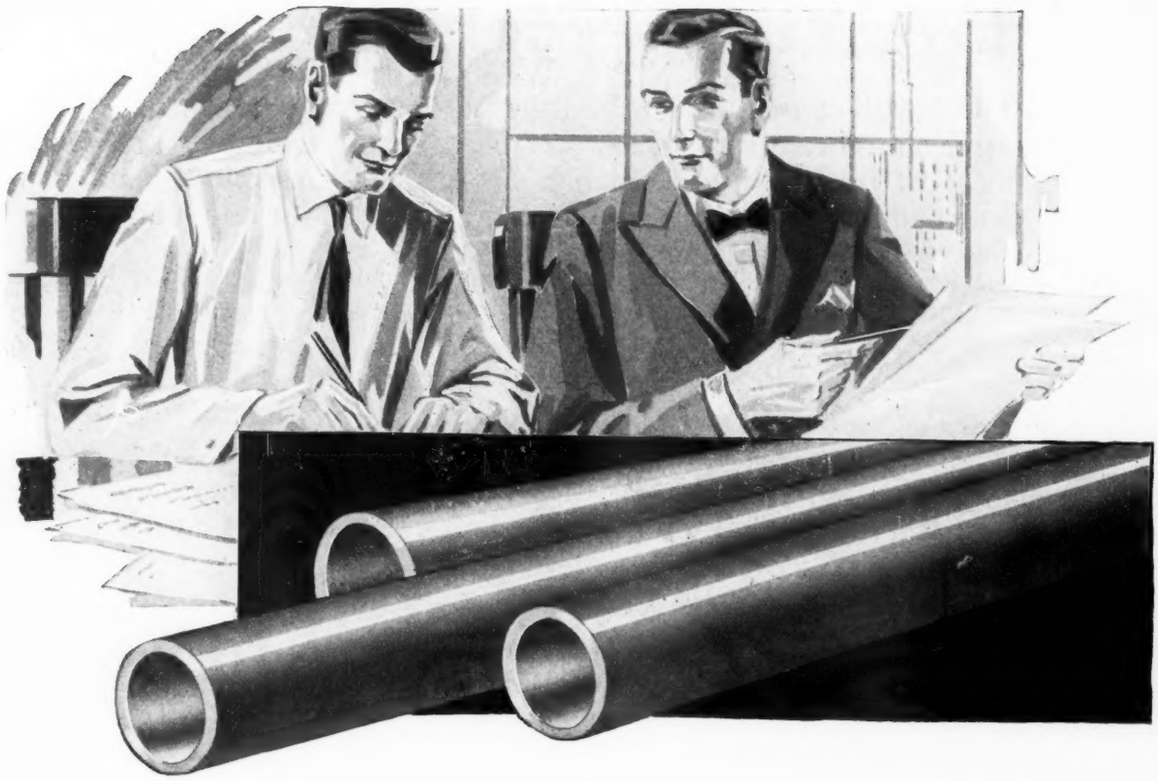
New York, New Orleans, Memphis, Chicago, Kansas City, Greenville, S. C., Houston, Tex., San Francisco, Havana, Cuba, Honolulu, H. T.

LOMBARD DIESEL ENGINES
100 TO 600 H.P.
THE LOMBARD GOVERNOR CO. ASHLAND MASS.

NOT PRICE ALONE



THE responsibility placed upon the purchasing agent of today is based on merit. No longer does price alone govern purchases. The up-to-date man in this position considers an order for condenser tubing with an eye to the length of service life expected, the elimination of splitting or season-cracking and the resistance to corrosion. That is why so many firms are replacing their tubes with Scovill Admiralty Condenser Tubing. They know that every operation in the manufacture of Scovill Tubing is supervised by trained men, that modern methods prevail throughout the Scovill plant. And they find that in the long run Scovill Condenser Tubing is most economical.

Scovill means **SERVICE** to all who require parts or finished products of metal. Great factories equipped with the last word in laboratories, and modern machinery manned by skilled workmen, are at your disposal. 'Phone the nearest Scovill office.

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STEAM GENERATION

The hourly demand for steam—steady or peak, steam pressure, superheat, fuel, feedwater, and space available, are some of the variables which make the requirements of a boiler plant individual. The proper apparatus for one plant may not prove good engineering for another.

Steam boilers of different types each have definite characteristics of performance. It is desirable to both manufacturer and user that equipment be installed which is best suited to the particular plant requirements. In order to meet this varied demand for boilers Wickes offers four types of Proven Units—the Horizontal Return Tubular; Water Tubes—Vertical, Horizontal Cross Drum, and Three Drum Curved Tube.

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Established in 1856
SALES OFFICES:
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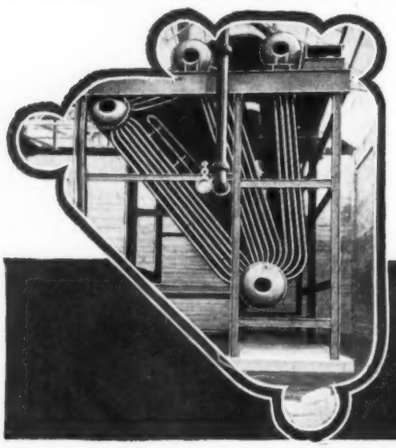

SELF DRAINING!

THERE are no pockets in the tubes of a Connelly Boiler to collect scale or mud and when drawing off the water the entire boiler empties. The catalog explains this and many other features of Connelly boilers. Write for it.

Built in units from 200 to 4300 H.P. and for steam pressures up to 450 lbs.

The CONNELLY BOILER COMPANY
1700 Ivanhoe Rd. Cleveland, Ohio
53 Years Knowing How

KINGSFORD

All Steel Sectional Water Tube Boilers

A design and construction that has proved its high efficiency under all steaming conditions. Also builders of horizontal and vertical Unaflow Engines and all types of Centrifugal Pumps. Write for Catalog.

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Over 40 Years Experience
COATESVILLE BOILER WORKS
Coatesville, Pa.

Mettler Entrained Combustion Gas Burners

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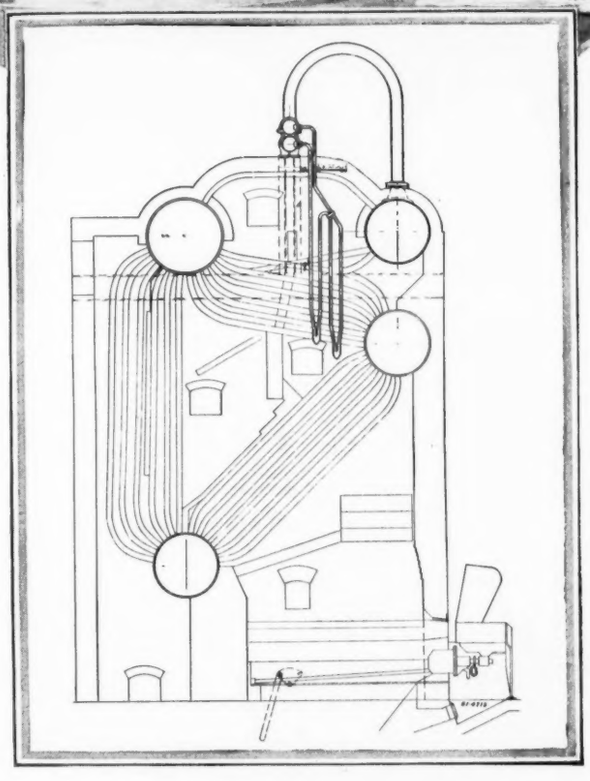
WATER TUBE BOILERS

UNION IRON WORKS ERIE PA.

LONG DRUM CROSS DRUM BENT TUBE



No maintenance expense during six years of operation

Long life and freedom from operating troubles are characteristic of Elesco superheaters. Over six years' operation in the three 415-hp. Kidwell boilers at the New Castle Leather Company, Wilmington, Delaware, without repairs is a performance which reflects excellency in design.

Elesco superheaters are designed and constructed to give long life. In their construction only materials are used which have proved the most satisfactory. Their design provides protection against strains due to temperature and pressure changes.

Write for a copy of "The Elesco Superheater for Power Plants."

THE SUPERHEATER COMPANY

17 East 42nd Street, New York

Peoples Gas Bldg., CHICAGO — **Union Trust Bldg., PITTSBURGH**

CANADA: The Superheater Company, Limited, Montreal

A-130 **Atlanta Charlotte Denver Houston** Represented in **Kansas City Memphis New Orleans San Francisco**

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Manufacturers of

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STEEL TUBES

For Stationary, Locomotive and Marine Boilers

For over twenty years, the Company's mills have been making high grade tubes for Babcock & Wilcox boilers. The same careful selection of raw materials, close supervision of manufacture and rigid final inspection are followed whether the tubes are made for Babcock & Wilcox boilers or for any other purpose.

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BOILER TUBES
BOILER TUBES
BOILER TUBES

Charcoal iron and lap welded steel boiler tubes are the product of our more than 35 years' experience.

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that FIT the boiler
Straight or Bent
any size
immediate shipment
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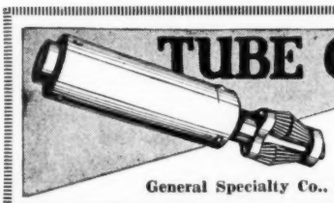
Niles, Ohio

TUBE CLEANERS



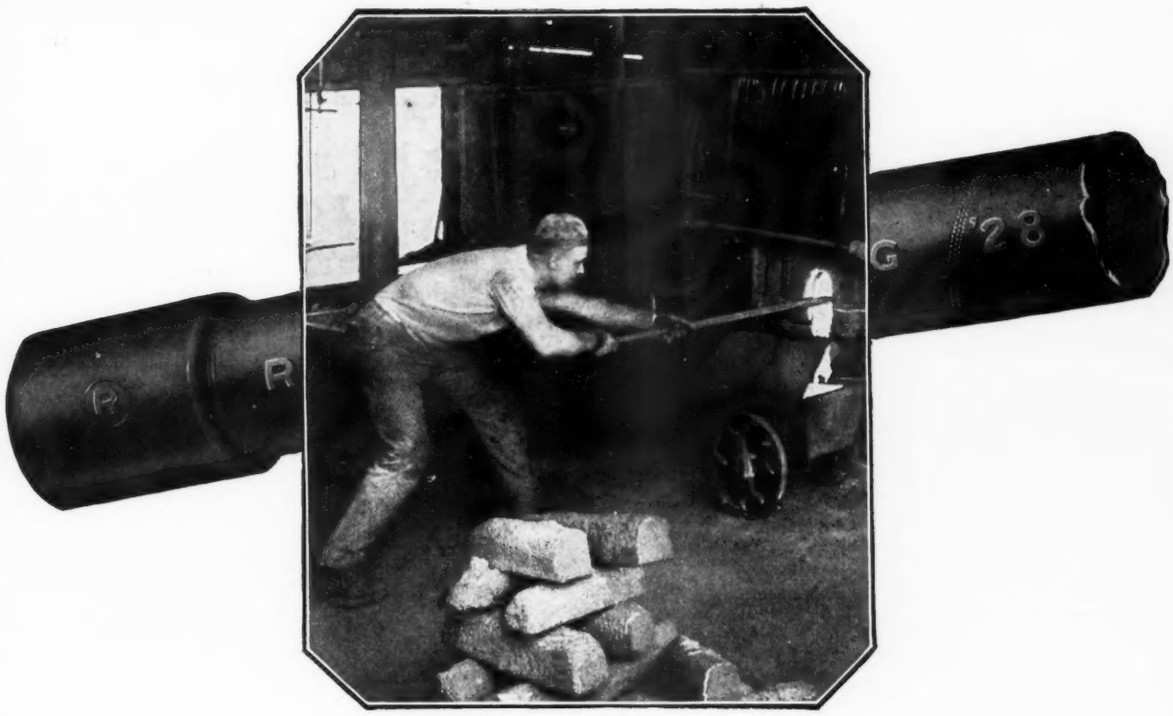
For water tube and fire tube boilers.

Write for FREE TRIAL offer and bulletins.

General Specialty Co., 67 Carroll St., Buffalo, N. Y.

SPRINGFIELD BOILERS

WATER TUBE BOILERS
SECTIONAL
ALL STEEL
Springfield Boiler Co.
Springfield, Ill.



Comparisons~

The quality of any product is determined by comparing that product with others of a similar kind

FROM its modest beginning, in 1848, the organization of the Reading Iron Company has been developed upon the basic idea that our product must surpass others by comparison.

The analysis and close inspection of raw materials; the inherent quality builded into every pipe through a combination of scientific design, good workmanship and accurate heat treatment; and lastly, the insistence on a carefully finished product—all are part of our pre-determined plan to make "Reading" the standard pipe.

Reading Genuine Wrought Iron Pipe is the only pipe that successfully resists the corroding elements that soon end the usefulness of inferior pipe.

It gives long life that is free from the expense and annoyance of pipe replacement. And its ultimate cost is so low that you can't afford not to use it.

READING IRON COMPANY
Reading, Penna.

READING PIPE
GENUINE WROUGHT IRON

DURABLA

Trade Mark Reg. U. S. Pat. Office

DURABLA GAUGE GLASS

for

400 Lbs. Steam Pressure

CLEAR "It's Safe" LASTING

BLOWN FROM THE ORIGINAL DURABLAMASS WHICH HAS NO SUPERIOR.

IT SHOWS THE WATER LINE CLEAR AT ALL TIMES.

Durabla Manufacturing Co., 114-118 Liberty St., N.Y.

New York Philadelphia Pittsburgh Dallas Chicago San Francisco Montreal

DURABLA

SHEET PACKING–ROD PACKING–VALVE DISCS–PUMP VALVES

SEASONAL VARIATION AT KANSAS CITY

LAB. NO.	87727	94685	95327	96957	98453	106055	107947	10
DATE	8/3/23	12/22/24	2/13/25	5/27/25	9/16/25	1/10/27	4/12/27	5/
Silica	.034	.746	1.003	.513	.700	.759	1.354	
Oxides of Iron & Aluminum	.116	.070	.116	.046	.070	.070	.070	
Carbonate of Lime	3.542	6.109	7.433	5.695	2.492	7.485	4.206	4
Chloride of Lime	-	-	-	-	-	-	-	
Nitrate of Lime							-	
Sulphate of Lime						98	5.558	6
Carbonate of Magnesia						75	2.724	3
Chloride of Magnesia							-	
Nitrate of Magnesia							-	
Sulphate of Magnesia							-	
Sod. Pot. Sulphates						79	6.275	10
Sod. & Pot. Chlorides						40	1.700	3
Sod. & Pot. Carbonates							-	
Sod. & Pot. Nitrates						32	Trace	
Loss, etc.						61	.070	
Total Sol. Min Solids*						00	21.957	2
Oil & Organic Matter						86	.700	
Suspended Matter							-	
Free Acid							-	
Total Sol. Incrusting Solids						97	13.912	15
Total Sol. Non-Inc. Solids						90	8.745	13
Pounds Sol. Inc. Solids						9	1.99	
Pounds Sol. Non-Inc. Solids						8	1.25	1

Scaling
Foaming
Corrosion

All in the Same Water, Stopped with Vegetable Matter

Missouri River water carries about two pounds of scaling matter to a thousand gallons of water. It is about one-third calcium sulphate, with nearly an equal amount of soluble soda salts. There is constant danger of foaming.

When properly combined vegetable matter is used, the deposits found in the boilers are soft and easily removed. There is no trace of corrosion. The boiler concentrations are safely carried beyond 500 grains per gallon without the slightest suggestion of foaming.

With conditions such as this, and with every other type of water supply used for making steam, Dearborn has had close contact for over forty years. Who is better qualified to work with you?

DEARBORN CHEMICAL COMPANY

310 S. Michigan Avenue CHICAGO

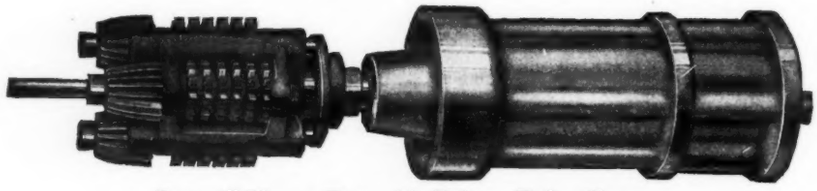
299 Broadway NEW YORK

Dearborn REG. U.S. PAT. OFFICE

Canadian Offices and Factory: 2454-64 Dundas St., West Toronto

Four Cleanings a Year May Be Cheaper Than One

The average cleaning time per boiler is reduced by more frequent cleaning and more uniform efficiency of the boiler is maintained.



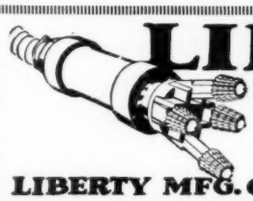
Roto 4" Heavy Duty Air-Driven Tube Cleaner

THE ROTO COMPANY, Sussex Ave. and Newark St., NEWARK, N. J.

Lagonda Tube Cleaners

Tube Cutters, Reseating Machines

The LAGONDA MANUFACTURING CO., SPRINGFIELD, O.



LIBERTY CLEANERS

for all sizes and types of tubes

LIBERTY MFG. CO., JEANNETTE, PA.

"MAGIC" Boiler Preservative

Twenty-Five Years' Experience!

Positive proof that "Magic" WILL do the work, i.e., prevents and stops scale formation, minor leaks, pitting and corrosion.

MAGIC "THE FILM OF PROTECTION FOR BOILERS"

GARRATT-CALLAHAN CO.

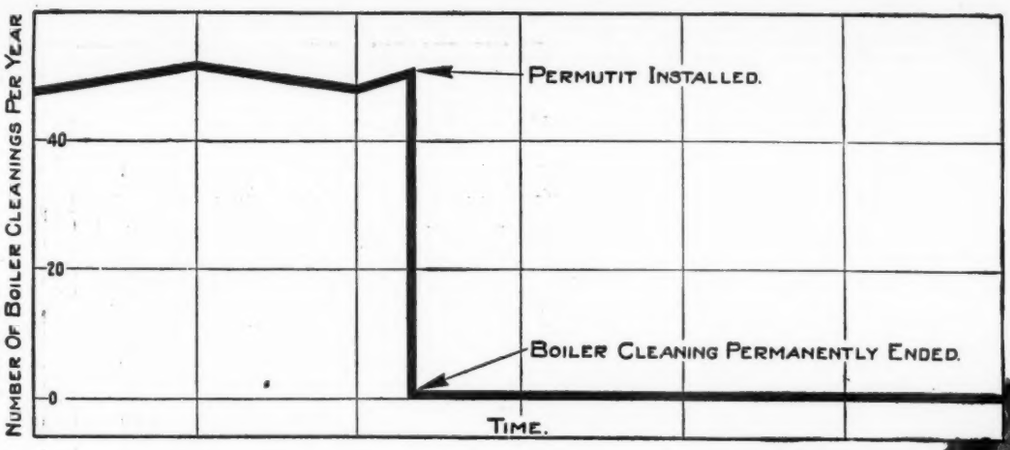
New York CHICAGO San Francisco

APEXIOR REG. U.S. PAT. OFF.

—an accepted protective coating for hot water and steam surfaces of boiler plant equipment.

Write for Bulletin

The DAMPNEY CO. OF AMERICA, Hyde Park, Mass.



All of the trouble and work and expense of boiler cleaning is eliminated by Permutit Water Softeners.

52 Boiler Cleanings eliminated each year in Kansas power plant

The Chief Engineer of a public service plant in Kansas operates six boilers developing 1985 hp. The plant delivers 24-hour service every day throughout the year.

The makeup feed water comes from private wells, bored 51 feet deep. Although clear, the water contains quite a lot of hardness. This caused a hard scale in the boilers, a scale that formed so rapidly that each boiler had to be taken out of line and turbined every six weeks. As there were six boilers, this meant that a boiler was cleaned every week in the year.

Finally the Chief Engineer determined to get rid of this boiler scale pest. He knew that others had done it, and he investigated their methods. At last he put his troubles up to Permutit engineers. They analyzed the working conditions of the plant and recommended the proper type of water softener which he installed.

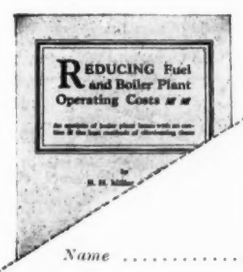
He still uses the same well water. But now when it reaches his boilers after passing through the Permutit Softener every bit of hardness has been removed. He has a constant supply that is even better for his purpose than rain water. Here is what the Manager of the plant wrote:

> "Before the Permutit Softener was installed we were compelled to employ two men continuously, at an expense of $260.00 per month, to keep the boilers clean. We now have no expense at all, as what washing is necessary is taken care of by the fireman. We find that a boiler can stay on the line indefinitely, and is only taken out of service for the purpose of cleaning soot and ashes and for inspection. The tubes are always found clean and bright and free from scale."

No more boiler scale in this plant. No more bagged tubes, no more clogged feed water pipes. Furthermore, the cost of coal per pound of steam delivered, dropped to a new low level as soon as the Permutit Softener was put on the job. Repairs and replacements rarely are needed now.

Let us send you our booklet "Reducing Fuel and Boiler Plant Operating Costs," it contains much valuable information about boiler feed water problems. There is no cost or obligation.

THE PERMUTIT COMPANY
440 Fourth Avenue, New York



The Permutit Company
440 Fourth Ave., New York

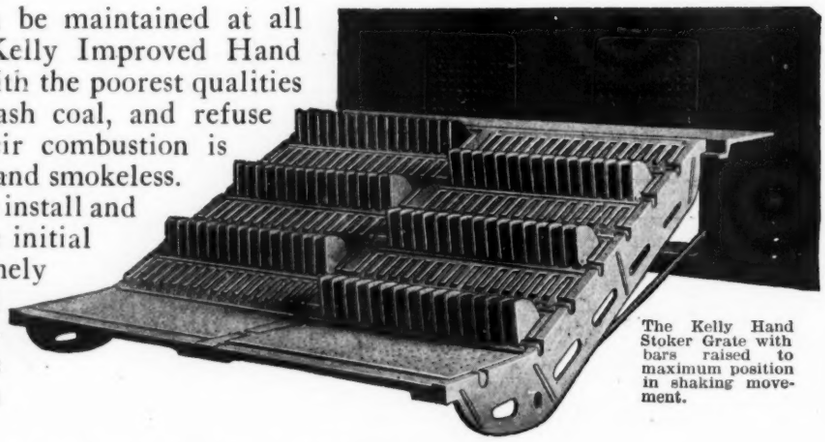
Please send me your free booklet, "Reducing Fuel and Boiler Plant Operating Costs."

Name ..... *Position* .....
Company .....
Address .....

KELLY

Combustion is extra heavy on the
KELLY IMPROVED HAND STOKER

Clean fires can be maintained at all times on the Kelly Improved Hand Stokers, even with the poorest qualities of low fusion ash coal, and refuse mixtures. Their combustion is highly efficient and smokeless. They are easy to install and operate and the initial cost is extremely moderate. Full details and particulars will be gladly sent on request.



The Kelly Hand Stoker Grate with bars raised to maximum position in shaking movement.

THE KELLY FOUNDRY & MACHINE CO.

614 NINTH ST. Est. 1887 GOSHEN, INDIANA

Chicago Offices
77 W. Washington St.
178 W. Adams St.

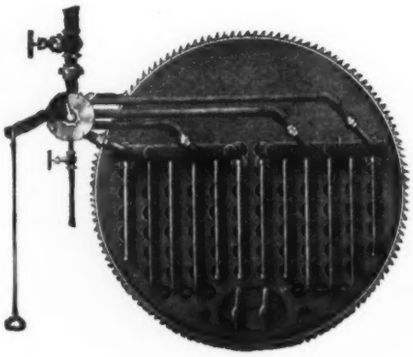
New York Office
53 Park Place

KELLY

Firemen are seldom "fired"—they quit

They balk at too much dirty work. Blowing boiler tubes *by hand* is about the meanest job in the plant. If you don't believe that, try it just once! See how you like to have soot blown back into your face, not to mention the terrific heat and occasional scalds and burns.

Firemen never shirk cleaning the National way—it is so easy and it means less shoveling of fuel. It eliminates the overtime expense and dissatisfaction of hand cleaning.



NATIONAL Soot Blowers do the Dirty Work Better

Turn the dirtiest part of the firemen's duties over to a National. Blow the soot out thoroughly behind closed doors. The National operates with a minimum of steam. Soot can be removed as fast as it accumulates. There is no chance for a single tube to escape cleaning.

We send the National out as its own salesman. It reduces tube repairs and saves sufficient fuel to pay for itself in a few months.

Installation is simple. No upkeep cost.

Let us send you a National for thirty days' free trial

National Flue Cleaner Co., Inc.
10 Church Street, Groveville, N. J.

VULCAN SOOT CLEANER COMPANY

MANUFACTURE DuBOIS PA. OFFICES IN THIRTY CITIES

Webster Bldg., DuBois, Penna.

Soot Cleaners For All Types of Water Tube and Return Tubular Boilers, Super-Heaters and Economizers.

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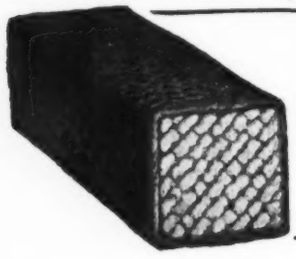
CONTINUOUS REGENERATIVE COUNTERFLOW

Recovers 70% stack heat, raises CO_2, improves combustion—*Bulletin on request.*

THE AIR PREHEATER CORPORATION
25 Broadway, N. Y. Works, Wellsville, N. Y.



For all steam pressures

Chesterton's Number 64 Packing provides additional slippage because of a special graphite compound between the sections. This prevents the packing from becoming hard.

Ask your dealer for prices, etc.

To insure tight steam joints use "Tenax"

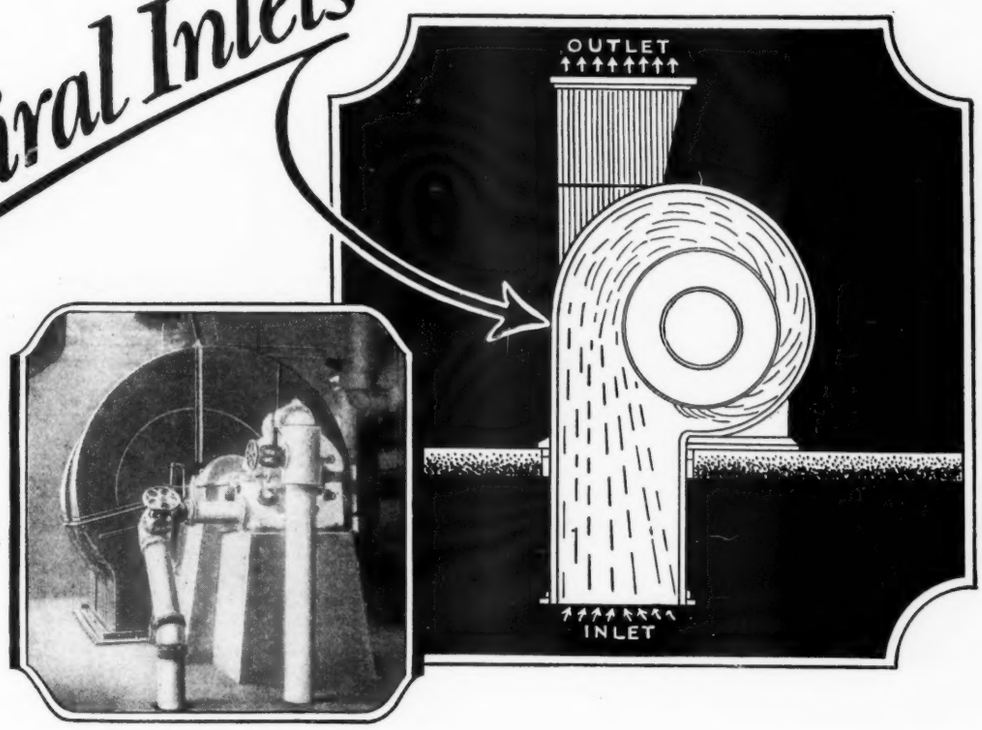
the Original Blue Sheet of Compressed Asbestos. Here is a time-tried product that has won the confidence of thousands of users.

Don't forget "Sonderglass"—the Unbreakable Gauge Glass, at your dealers or send direct.

TENAX

A. W. Chesterton Co. or Advance Packing & Supply Co.
64 India St., Boston, Mass. 808 Washington Blvd., Chicago

Spiral Inlets



A Turbovane Type I.D. Feature

Greatly reduces power consumption—raises efficiency

FOR a power plant to purchase an efficient induced draft fan—and then to use an inlet box of *unknown* efficiency—long has been common practice. That the box should have an inlet area large enough to permit the entrance of air usually has been the *only* requirement.

Now it has been found—by actual test—that such a box, if poorly designed, can take up as much as 25% of the pressure which the fan is called on to create!

In the Turbovane Type "I.D." Induced Draft Fan, the inlets are scientifically designed and *built right into the unit!* Inlet friction losses are *pre-controlled*—and reduced to a minimum. The fan is tested with the inlet boxes in place.

Because of the spiral design of the inlets, hot gases do not twist or turn as they are drawn into the fan. They are guided with a minimum of friction to the fan impellers. Eddy currents and pockets are eliminated—gases are distributed evenly to the impeller throughout its entire circumference—and the conditions of actual installation are exactly the same as the test conditions.

It is features like this that make the Turbovane, Type I.D. so successful and efficient for induced draft work. Full details will be gladly supplied by our nearest office.

B. F. STURTEVANT COMPANY, HYDE PARK, BOSTON, MASS.

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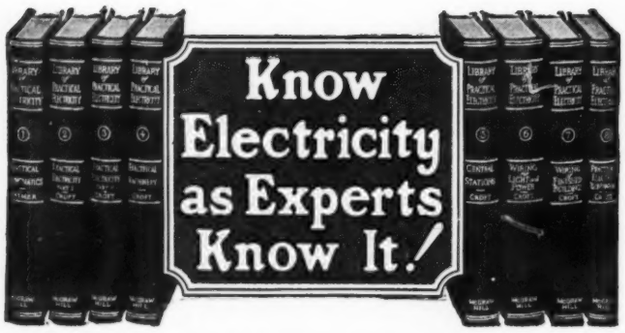
Canadian Offices at: Toronto, Montreal and Galt, Ont. Also Agents in Principal Foreign Countries

Sturtevant REG. U.S. PAT. OFF. *Forced Draft Induced Draft* **FANS**

STEAM TURBINES ~ FORCED AND INDUCED DRAFT FANS ~ ELECTRIC MOTORS
FUEL ECONOMIZERS ~ GENERATING SETS ~ AIR PREHEATERS



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Whether your need is for feed water, a heating system or a manufacturing process or a domestic purpose—the cost will be less if you heat the water in

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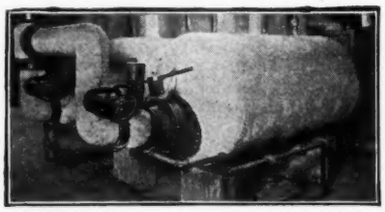

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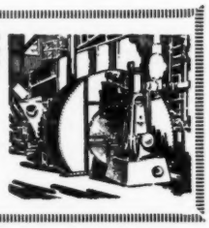

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Sales Engineering Offices in Principal Cities

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for mechanical draft heating and ventilating

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FOR EVERY BOILER—STOKERED OR HAND FIRED

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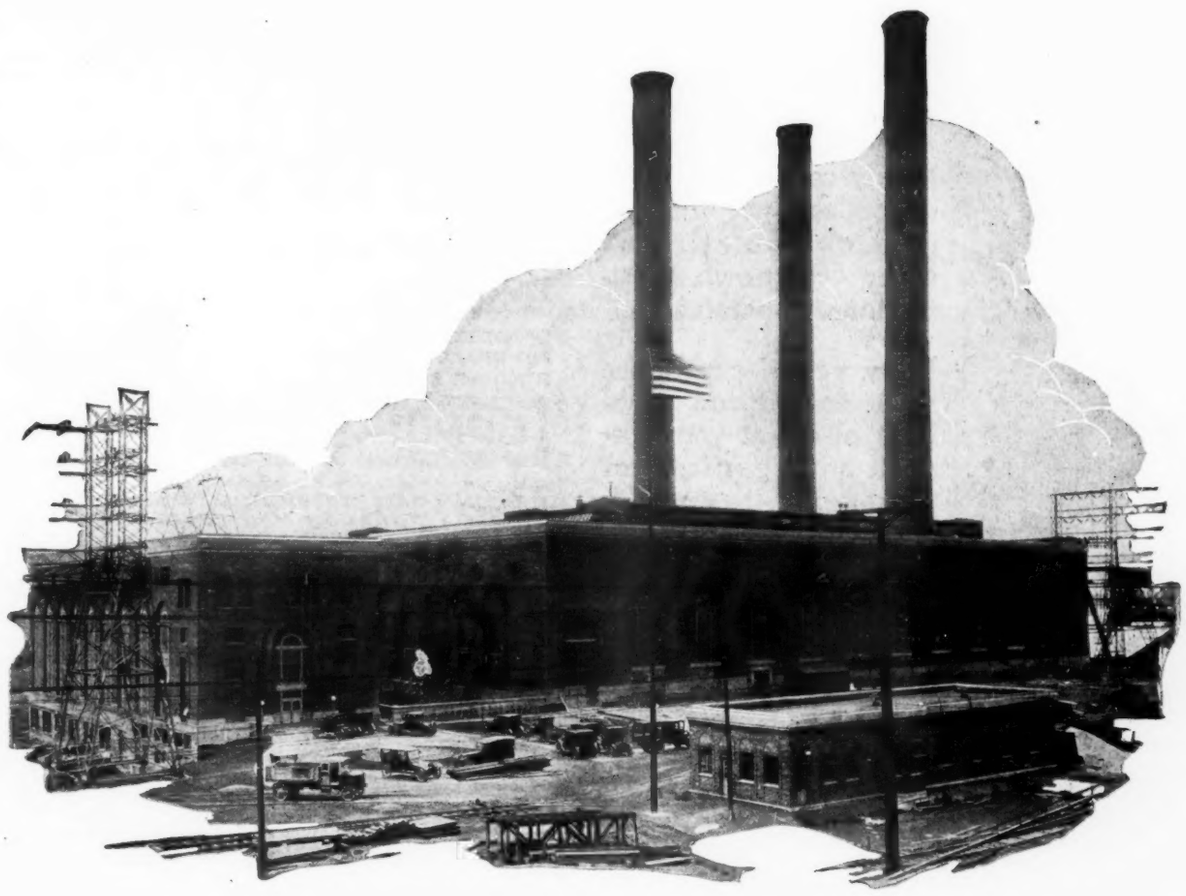
The Toledo Edison Company, Toledo, Ohio, a part of the nationally known Cities Service Company, have decided to install complete Smoot Control of Combustion at their Acme Station.

This addition of Smoot Control to this modern power plant is in line with the policy of the Toledo Edison Company in meeting the demands for power of the rapidly growing city of Toledo.

This installation of Smoot Control is one more case where this system was required to prove its value before complete adoption. Two boilers have been operating with Smoot Control for one year and the result is another repeat order for complete Smoot Control.

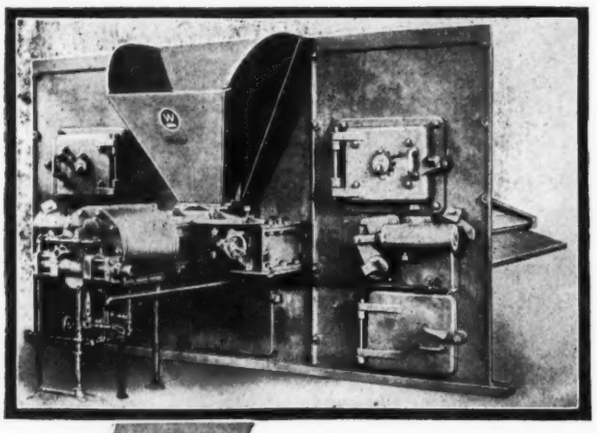


SMOOT ENGINEERING CORPORATION

136 Liberty Street **New York**

Stokers

WESTINGHOUSE ELECTRIC



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IN Westinghouse stokers, you find the same progressive engineering, sturdy construction and dependable performance that characterize all other well-known Westinghouse apparatus.

Forty years' experience with combustion problems places at your disposal an organization thoroughly prepared, and at all times ready to consult with you on any commercial coal burning problem.

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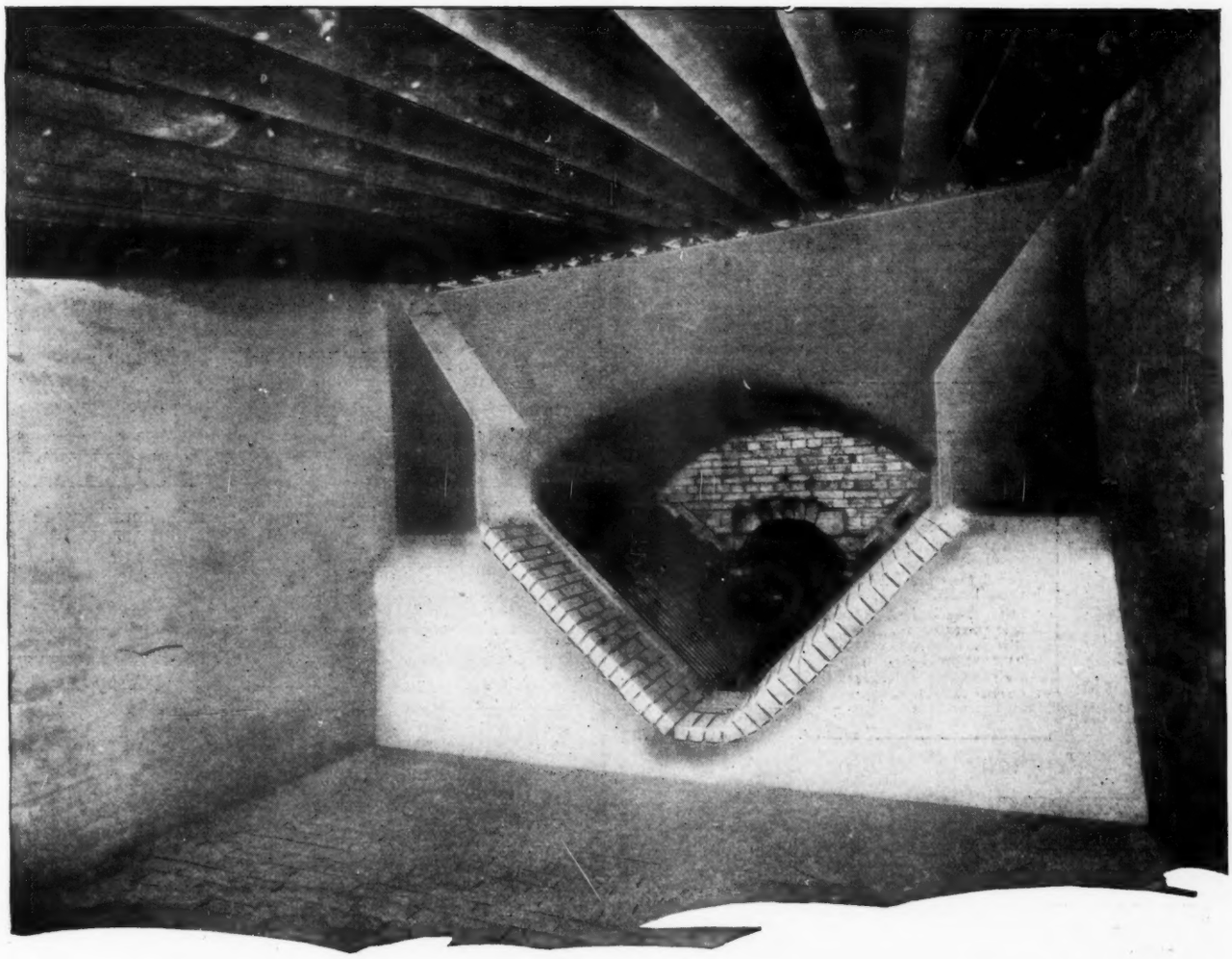

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When applied in a thin grout with a brush over the face of the furnace refractory lining, it will vitrify into a hard glaze that resists high temperatures and mechanical abrasion.

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Unsurpassed in insulating value as a protection to structural steel and other surfaces exposed to high heat. Use it on top of furnace arches and over brickwork to seal them against cold air infiltration and to reduce radiation losses.

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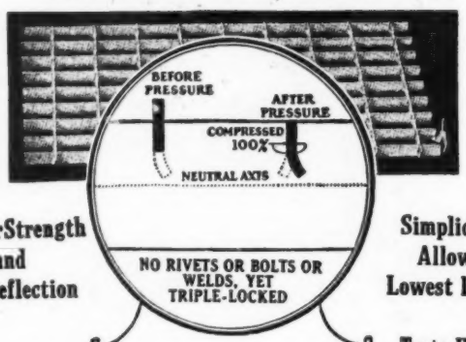

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First, there is a right-twist lock in every other bar.
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Third, there is the 1600-ton hydraulic pressure-lock, which is effected by *pressing* the cross bars into the two twist-locks.
Time nor wear can not open the three locks of TRI-LOK.

Ventilated Steel Flooring

THE TRI-LOK COMPANY 5549 BUTLER STREET PITTSBURGH, PA.

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UNIPULVO
UNIT PULVERIZER
FOR EVERY BOILER
From One Hundred to One Thousand Horsepower
THE STRONG-SCOTT MFG. CO.
MINNEAPOLIS, MINNESOTA
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The stoker for the higher volatile coals, dominant in this field today.
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Hand Stoker (Heavy Duty)
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A Stoker for Every Boiler
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Send for a Copy of "Five Minutes with the Coal Bill".
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PIONEERS IN ELECTRICAL COMBUSTION CONTROL
We have a system to meet your requirements!
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AUBURN *HEAVY DUTY* STOKER
A Full Mechanical overfeed stoker. Natural or Forced Draft; Sizes 150 to 3000 H.P.
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A high class, fully automatic underfeed stoker for low set and internal firebox boilers. Sizes from 5 to 500 H.P.
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COEN
for Increased Steam Production
MECHANICAL OIL BURNERS & IMPROVED AIR REGISTERS
Wide flexibility. Ideal flame control. A 100% load range without changing burner tip. Increased output of any type of boiler. Write for Bulletin "M."
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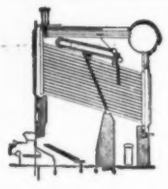

Enco Baffle Walls
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Combine gas-tightness, with flexibility and strength. Easily installed in existing settings.

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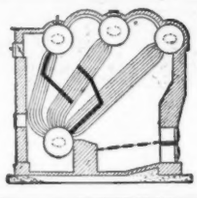
Improve boiler operation by the cross flow of gases, which produces better heat transfer and reduces draft drop.



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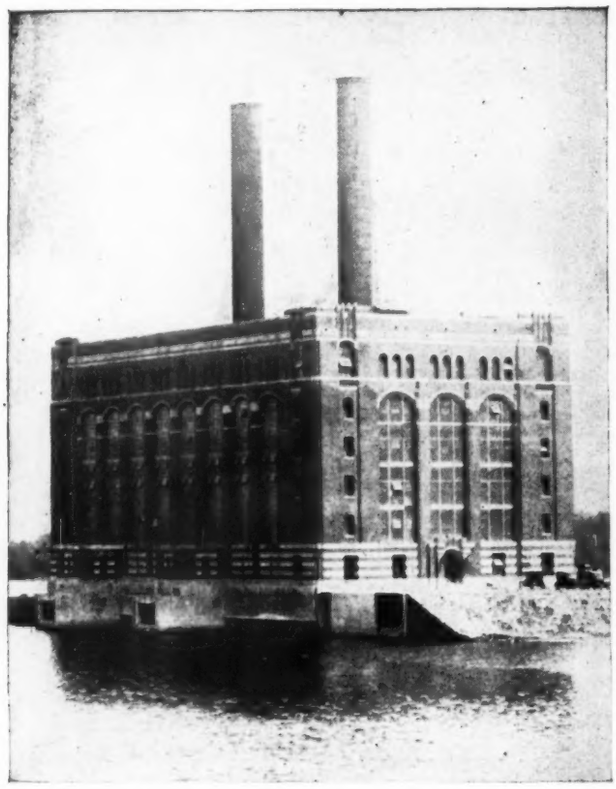

East Peoria Power Station of the Illinois Electric Power Co. in which Evens & Howard Fire Brick have proved "very satisfactory indeed."

A Few Degrees *make a* Big Difference!

It's the ability to stand the pace for the last ten feet that wins the race. It's the ability to withstand a few more degrees of heat that makes Evens & Howard Fire Brick your best choice. Power plants and other big users all over the land have discovered this and are consistently ordering and re-ordering

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These buyers appreciate the value of QUALITY when steady, high temperatures must be maintained day after day. It's the ability of Evens & Howard refractories to furnish this surplus of heat resistance that wins their buying preference—and deserves yours.

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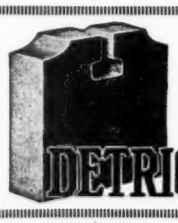

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Fire Clay, Silica, Chrome, Magnesite and Diaspore (High Alumina) Refractories. Grefco Chrome High Temperature Cement.

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In any size or shape you need

—all of them with 4 or 5 times normal life

Special coping brick designed for forced draft chain grate stokers, handling fine fuels, serves to prevent coal from being blown through Chain openings in boiler front. Economies in this direction approach at least 90 per cent. Especially designed for Coxe Stoker or Type E Stoker

Write us for Catalog, entitled:

"LAWTONITE REFRACTORY FACTS"

Complete linings—or parts of linings—pieces in *any* shape and size—special as well as standard bricks can be furnished at short notice in Lawtonite—the better refractory.

This means that you don't have to resort to a less serviceable refractory to meet the requirements of usual or unusual furnace design. No matter what the conditions, there's a Lawtonite shape or size for the job.

And Lawtonite has 4 to 5 times the life of ordinary plastic bricks.

This means correspondingly fewer shutdowns, lower furnace maintenance, less labor and lowered production costs.

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A Silicon Carbide Refractory of Special Composition

Better Refractories

PAGE BOILER MASONRY

Meets Highest Engineering Requirements

Power plant engineers, recognizing the importance of *correct* boiler setting, employ Page Service.

This brings to the job a reliable organization with engineers and skilled workmen who are specialists in boiler masonry.

The long list of successful boiler settings, furnace relinings, baffle wall installations and incinerators done by Page Service is an assurance your work will be properly executed and the job will cost no more than ordinary work—in fact less in the end.

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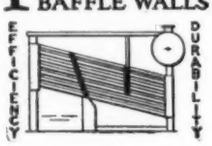
We are at your service for repairs or complete installations anywhere.

The Frederick Page Contracting Co., Inc.
45 E. 17th St., New York

Boiler Baffle Walls

PAGE BAFFLE WALLS



Boiler Furnace Walls

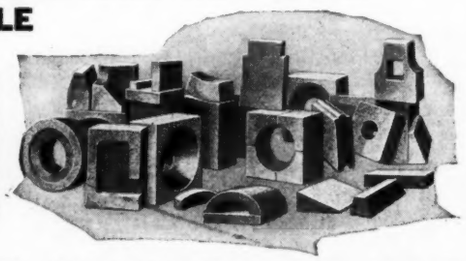
Boiler Settings

Incinerators

"Quality Service at the Right Price"

Make Your Own SPECIAL SHAPES and TILE

MIXTURE 100 lbs. Hytempite to 175 lbs. Refractory Material



USE Crushed old fire brick or Ganisand that will pass ¼" mesh (including the fines) mixed with

HYTEMPITE
(Reg. U. S. Pat. Off.)

Take enough Hytempite from the drum for a batch and place it in a mortar box, ready for diluting. Add water to form a smooth pancake batter. Then add the refractory material gradually until the mass is stiff enough to be handled without showing any free moisture. Pound it with a mallet or rammer into a wood or metal form to make Special Shapes or Tile.

Hytempite is also universally used for laying firebrick in all types of furnaces, boiler settings, arches, etc. (and when mixed with crushed old firebrick or Ganisand), for monolithic construction, baffles, patches, repairs, special shapes, etc. (see above), booklet H109R.

Stock and service men in every Industrial Center.

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Furnace Linings and Arches Boiler Door Arches, Furnace Lining, Back Arches, Flat Suspended Furnace Arches, Air Cooled Walls, Fire Brick, High Temperature Cement, Carbex (Silicon Carbide) super Refractories. *Write for Booklet 31.*

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Branch Offices: New York, Boston, Cleveland, Detroit.

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DURA-STIX

has achieved a dignified reputation for faithful service to industry.

Bonds and *Extends* the life of fire brick in the best known plants of America. *Booklet PH tells how.*

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Queen's Run Glass

THE UNEXCELLED REFRACTORY FOR BOILER FURNACE LINING

"LET US SERVE YOU"

QUEEN'S RUN REFRACTORIES CO. INC.
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SUPER REFRACTO BAFFLES

In your horizontal water tube boilers will direct and control the flow of the gases over the boiler tube surfaces in such a way as to permit the maximum amount of available heat to be transferred from the gases to the boiler and will remain intact in service.

Explained fully in Bulletin "A". Send your boiler blue print for a quotation.

POWER PLANT ECONOMY COMPANY
Boiler Baffle Wall Contractors
5473 DELMAR BLVD., ST. LOUIS, MO.

Standard shaking feeder delivering coal from a concrete hopper to a fixed bar grizzly.

Control the Feed of Coal . . . equipment will work better

Don't overload equipment.

Overloading conveyors results in spillage, undue sagging, belt strain. Overloading chokes crushers, fills up elevator boots. Nothing works well if overloaded.

It is better to control the feed to such equipment.

Conditions will dictate the choice of feeder. For some, Robins' engineers would recommend their straight belt feeder; for others, their steel apron feeder; and so on, selecting the most suitable feeder from the several types available.

So, for handling that coal in your plant and for delivering it in bulk, make use of a feeder—the right feeder.

Let Robins' engineers give you the benefit of their wide experience on just such a problem.

A note to our nearest office will be given prompt attention.

Types of Robins Feeders

Belt Conveyor
Steel Apron
Roll
Shaking
Reciprocating
Stationary
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Ash Handling Systems
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MATERIAL HANDLING
ROBINS
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Another American Rolling Ring *Crusher*

No. 61-42 American Ring Crusher installed in the Cleveland Electric Illuminating Co.'s plant. Belt driven from 75-hp. motor, reducing 150 tons per hour of r. o. m. coal to ¾-inch product.

Reducing Power Costs

Plant engineers know that greatest boiler efficiency is obtained when using properly-sized coal. Furthermore, uniformity of the product is absolutely essential when reducing coal at the power plant.

The American Rolling Ring principle, only available in American Crushers, not only enables plant engineers to crush r. o. m. coal in their own plant cheaper than they can buy it, but it gives a reliable uniformity of product.

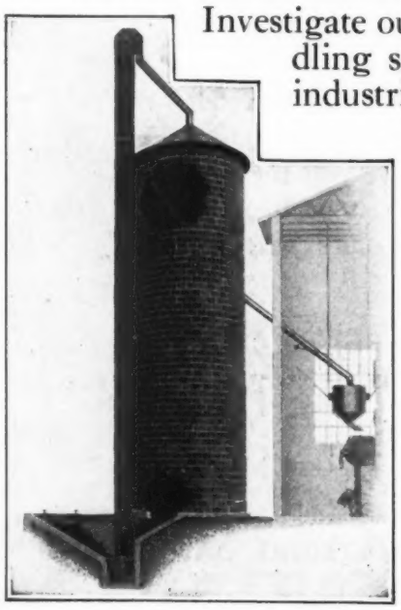
The Improved American Ring Crusher is equipped with such refinements as Timken Tapered Roller Bearings, Adjustable Grinding Plate, cast steel construction and manganese grinding parts.

ORIGINATORS OF THE ROLLING RING CRUSHER PRINCIPLE

AMERICAN PULVERIZER CO

1249 MACKLIND AVE. ST. LOUIS, MISSOURI

Save ⅔ of your Coal Handling Cost



Investigate our coal handling silos for the industrial plant. Large storage capacity—small ground space—unloading—reclaiming—*without manual labor.*

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Cast Iron Ash Hoppers~Tanks~Coal Bunkers
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AND SIZED TO MEET YOUR REQUIREMENTS

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Locomotive Cranes — Clamshell Buckets
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Cleveland, Ohio

BEAUMONT Cable Drag Scraper

for Coal Storage

Compact — Dependable — Durable

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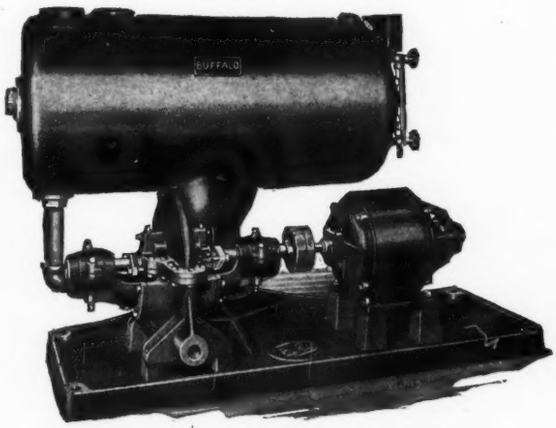
Handling 212° Condensate



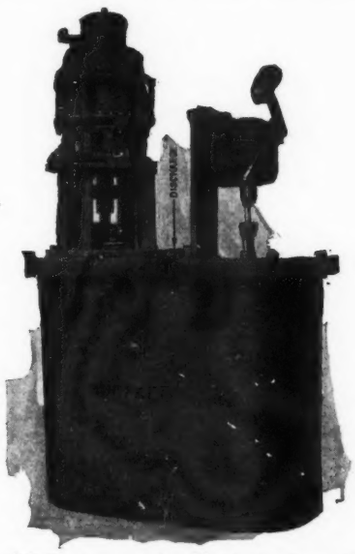
"Buffalo" Class "SL" Pump and Receiver

Buffalo Double Suction Class "SL" Pumps are made to pump 212° condensate without vaporizing, air binding, reduction in capacity or pressure and various other troubles that prevail in other condensate pumps.

High or low water temperatures, either above or below normal, do not overload these smooth running pumps. Absolutely self-priming. Made in several sizes, for all motor speeds with capacities up to 20,000 lbs. of condensate per hour, against heads up to 75 lbs.

Automatic Vertical Centrifugal Pumps and Receivers

This pump and receiver is very good for ordinary service, handling up to 10,000 lbs. of condensate per hour against heads up to 25 lbs. The heavy cast iron receiver, vertical ball bearing type thrust bearing, bronze impeller and sturdy construction in general makes this outfit very practical where it is necessary to dig a pit to permit gravity drainage.

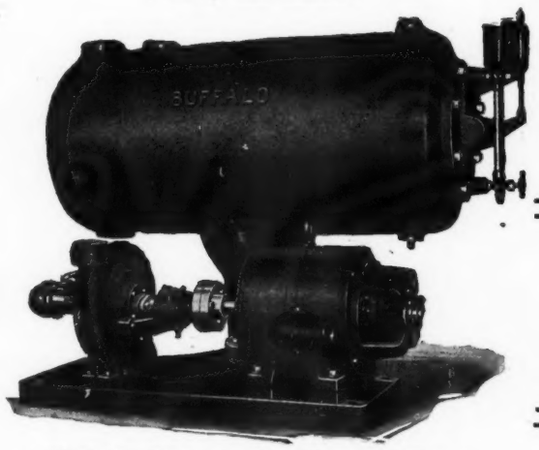


"Buffalo" Automatic Vertical Centrifugal Pump and Receiver

Single Suction, Class "O" Pumps

A medium-priced condensation outfit that will handle up to 15,000 lbs. of condensate per hour, at heads up to 25 lbs. Excellent for use where boiler pressure is too low to permit using a steam pump and receiver. Made in several sizes.

All inquiries gladly answered. Write today. No obligation.



"Buffalo" Single Suction Class "O" Pump

Buffalo Steam Pump Co.

488 Broadway, Buffalo, N. Y.

In Canada—Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

"Buffalo" Pumps for Condensation

Small Savings Made Big

Economies roll up big total in long service life of

WESTCO

SINGLE STAGE PUMPS

ON THAT next pump job, why not follow the lead of thousands of engineers who have "tried" Westco pumps and are now hard to satisfy with any other. In the Westco you have notable performance plus such inherent economies as:—

LOW POWER CONSUMPTION

The Westco requires smaller motors than other pumps of equal capacity. Savings frequently enough to pay for pump in one year.

ONE MOVING PART

There is no metal to metal contact in a Westco, consequently nothing to cause friction or wear. Nothing to get out of order.

BALL BEARING CONSTRUCTION

Selected radial and thrust ball bearings insure smooth, trouble-free operation over longer periods with minimum attention.

ABSENCE OF THRUST

The peculiar design of the Westco achieves perfect hydraulic balance and eliminates thrust.

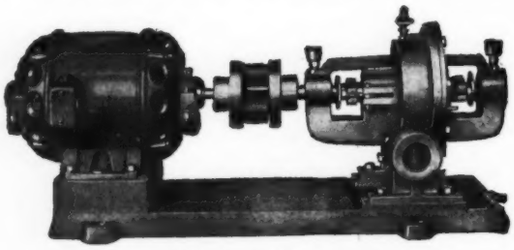
PRECISE MANUFACTURE

Every Westco is the product of accurate, precise machining to insure a consistently high standard of performance in each individual pump.

LONG SERVICE LIFE

Performance in the field has confirmed the promise implied in the Westco features described above. Years of unfaltering performance render the Westco a "paid for" investment many times over.

Take your first step toward Westco satisfaction by writing for Westco catalog and selection table today.



The Pump With the Wide Operating Range.

See descriptions of the Westco on Page 704 of Sweets 1928 Engineering Catalog.

WESTCO-CHIPPEWA PUMP COMPANY

Factory and General Offices—Davenport, Iowa

BRANCHES:

New York Chicago San Francisco

Distributors in Principal Cities

WESTCO-CHIPPEWA PUMP COMPANY

Dept. 0-7. Davenport, Iowa

Gentlemen:—Please send me your Latest Westco Catalog including the Westco Selection Table.

Name .....

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AMERICAN *locomotive* CRANES

—Steam

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Capacities from ten to forty tons.
Car trucks or Continuous Chain Treads.

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Coal for you with service too

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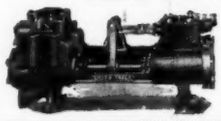
PLATT IRON WORKS - DAYTON, OHIO.

Smith-Vaile PLATT Pumps



Steam and Power Pumping Machinery

SEWAGE EJECTORS—CENTRIFUGAL PUMPS—AIR COMPRESSORS

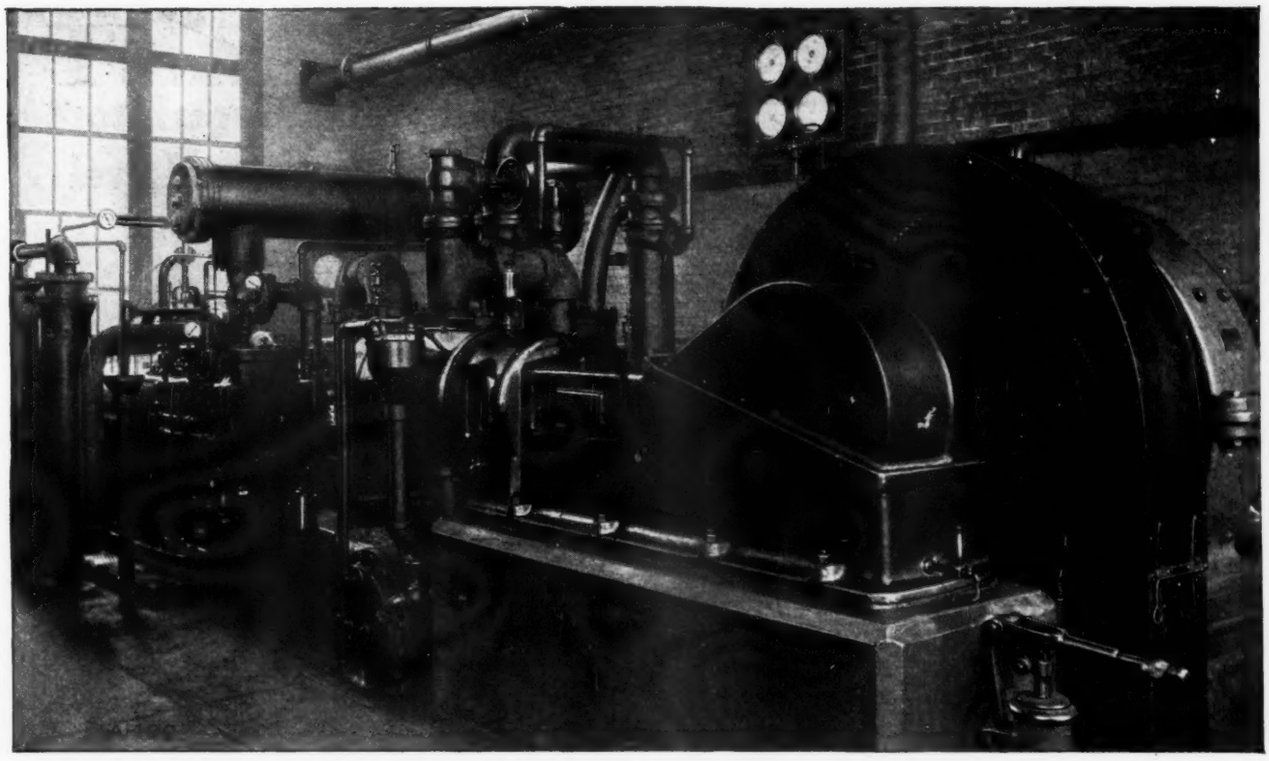
Jennings Pumps

NASH ENGINEERING CO. SOUTH NORWALK, CONN.

RoTURBo CENTRIFUGAL

PUMPS

Manistee Iron Works Co., Manistee, Michigan



18 and 11 x 14 direct-connected motor-driven Worthington Air Compressor (foreground) and steam-driven 11 and 21x21x12 Worthington Air Compressor (background) in the Wilmington, Delaware, plant of the Eastern Malleable Iron Co.

FEATHER Valve Air Compressor in *Malleable Foundry Service*

A WORTHINGTON FEATHER (Reg. U. S. Pat. Off.) Valve Air Compressor, illustrated above, was installed ten years ago in the Wilmington, Delaware, plant of the Eastern Malleable Iron Company.

This compressor is direct electric motor-driven, and supplies compressed air for sand blast machines and general purposes in this large foundry.

The compressor shown in the background at the left is a Worthington Cross-compound Steam-driven Air Compressor installed in 1908. Its long record of satisfactory service influenced the Eastern Malleable Iron Company to select the second Worthington compressor for its increased requirements in 1918.

The illustration above is from a photograph made in 1928, when the FEATHER Valve Compressor had been in service 10 years... the cross-compound, twenty.

Worthington FEATHER Valve Compressors are made in a comprehensive range of capacities... as to both volume and pressure. Like other Worthington products they are built to give satisfaction beyond reasonable expectations, in performance, length of service and minimum maintenance.

Inquiries for information on any problems involving air or gas compressors will receive prompt, competent attention, through the most convenient of the twenty-four Worthington district offices.

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PUMPS

COMPRESSORS

CONDENSERS
and Auxiliaries

OIL *and* GAS ENGINES

FEEDWATER HEATERS

WATER *and* OIL METERS

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WORTHINGTON

6741-31

Automatic Control

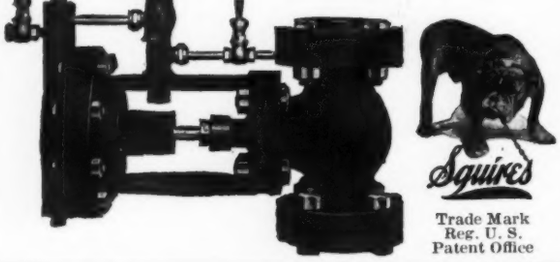
Squires

Class "E" Pump Governor

The mechanically simple, sturdy device insures proper control of your pump. It eliminates the hazards of manual operation and keeps pumps operating at their highest efficiency.

Catalog A-11 gives full particulars. Write for a copy.

The C. E. Squires Co.
E. 40th St. and Kelly Ave.
CLEVELAND, OHIO



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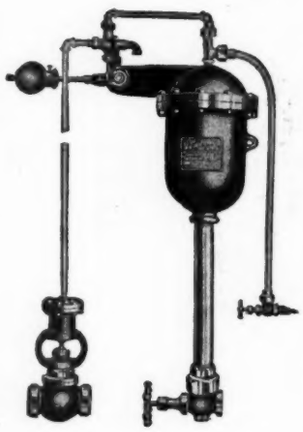
VIGILANT
Feed Water Regulators
Keep the Water Level At Middle Gauge



Beware of fluctuating water levels. Even though you disregard the danger, they are costly. It is impossible to obtain maximum economy and efficiency through hand regulation of boiler feeding. It takes automatic, mechanical regulation for that.

VIGILANT Feed Water Regulators hold the water level at a fixed point, under all operating conditions and at all boiler loads. Their use insures drier steam, increased boiler capacity, greater fuel economy.

Write for Catalog and Trial Offer

The Chaplin-Fulton Mfg. Co.
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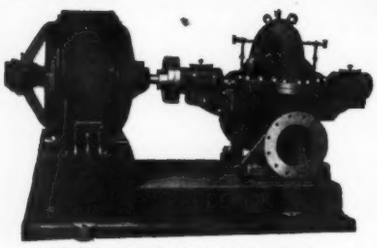

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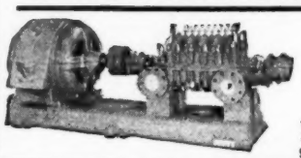

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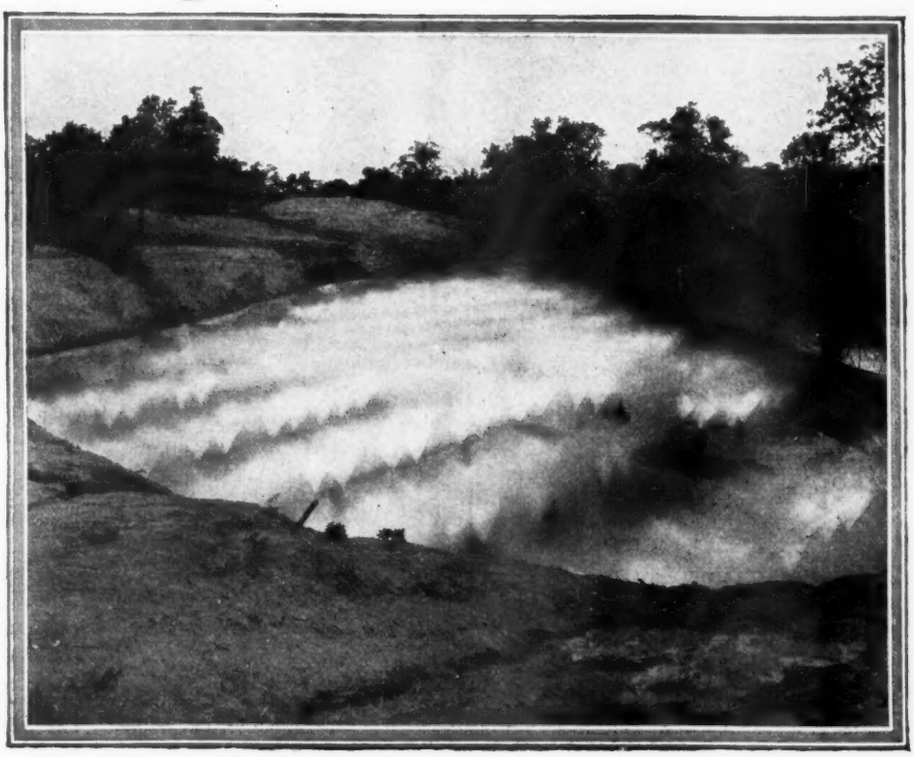

Spray Pond at the Byng Station, Oklahoma Gas & Electric Company.

THE photograph shows a part of the spray pond at the Byng Station of the Oklahoma Gas & Electric Company (operated by the Byllesby Engineering & Management Corporation). The pond has a capacity of 33,000 g. p. m. and is equipped with 708 Yarway Involute Non-clogging Spray Nozzles.

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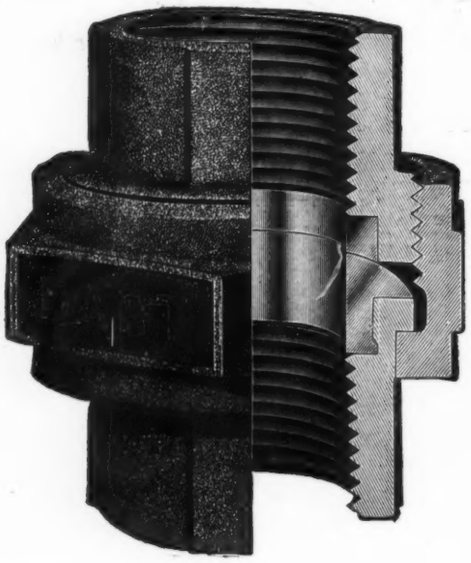

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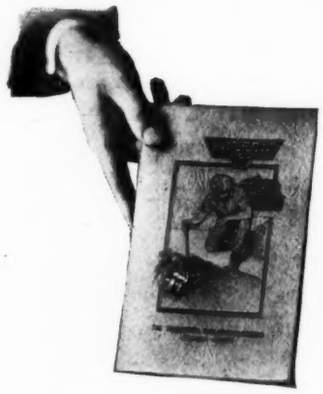

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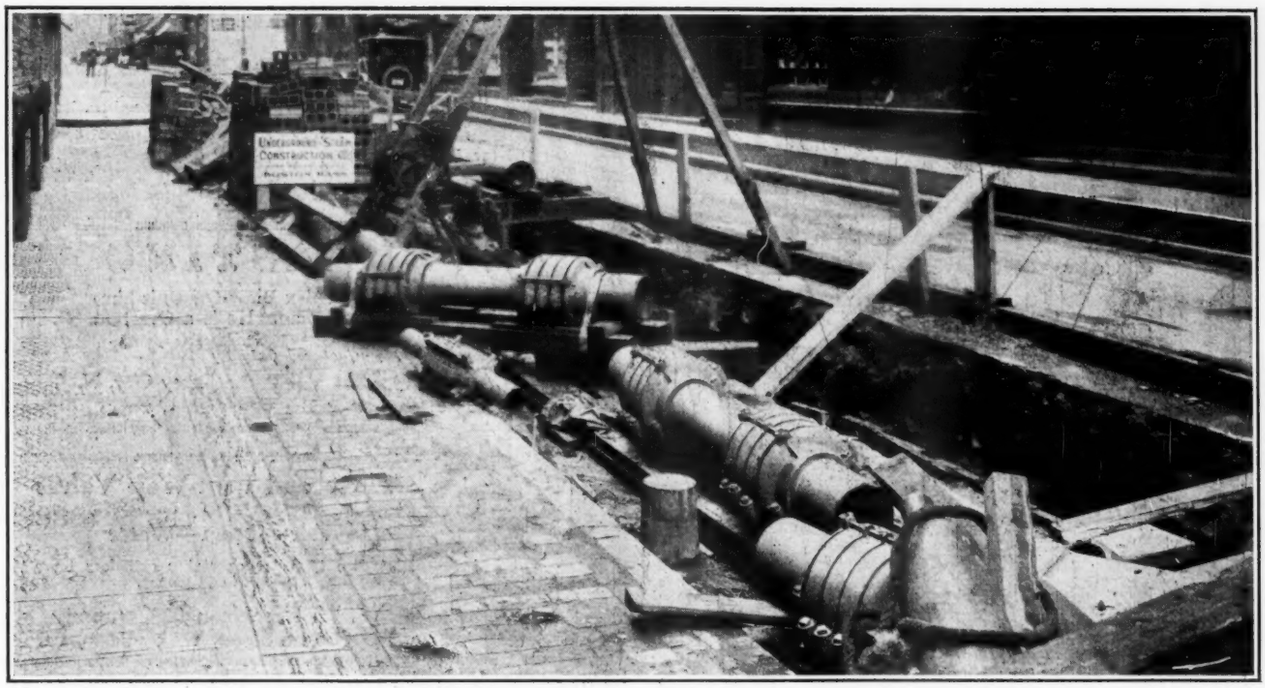

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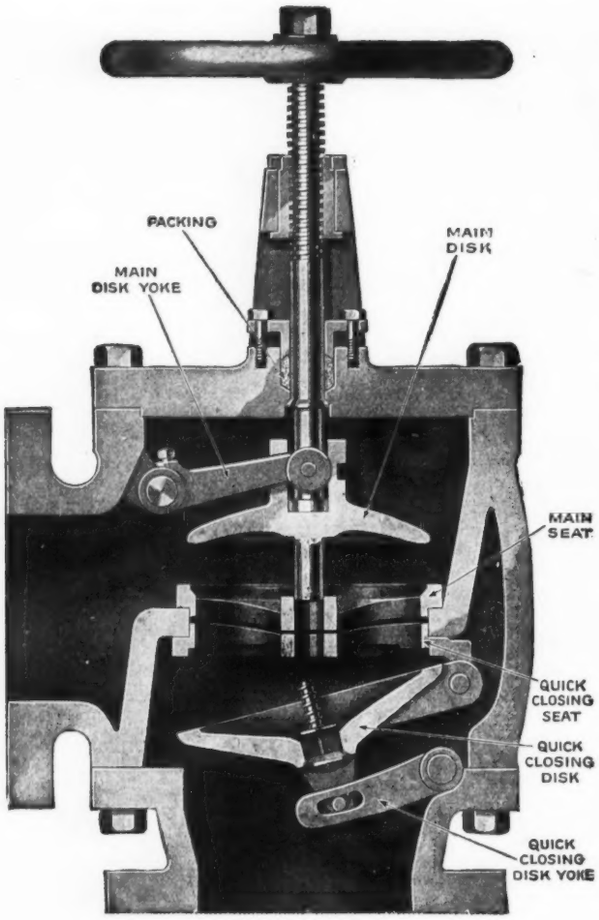

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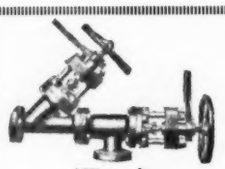

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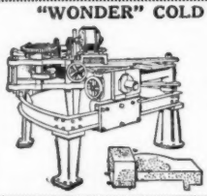

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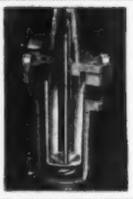

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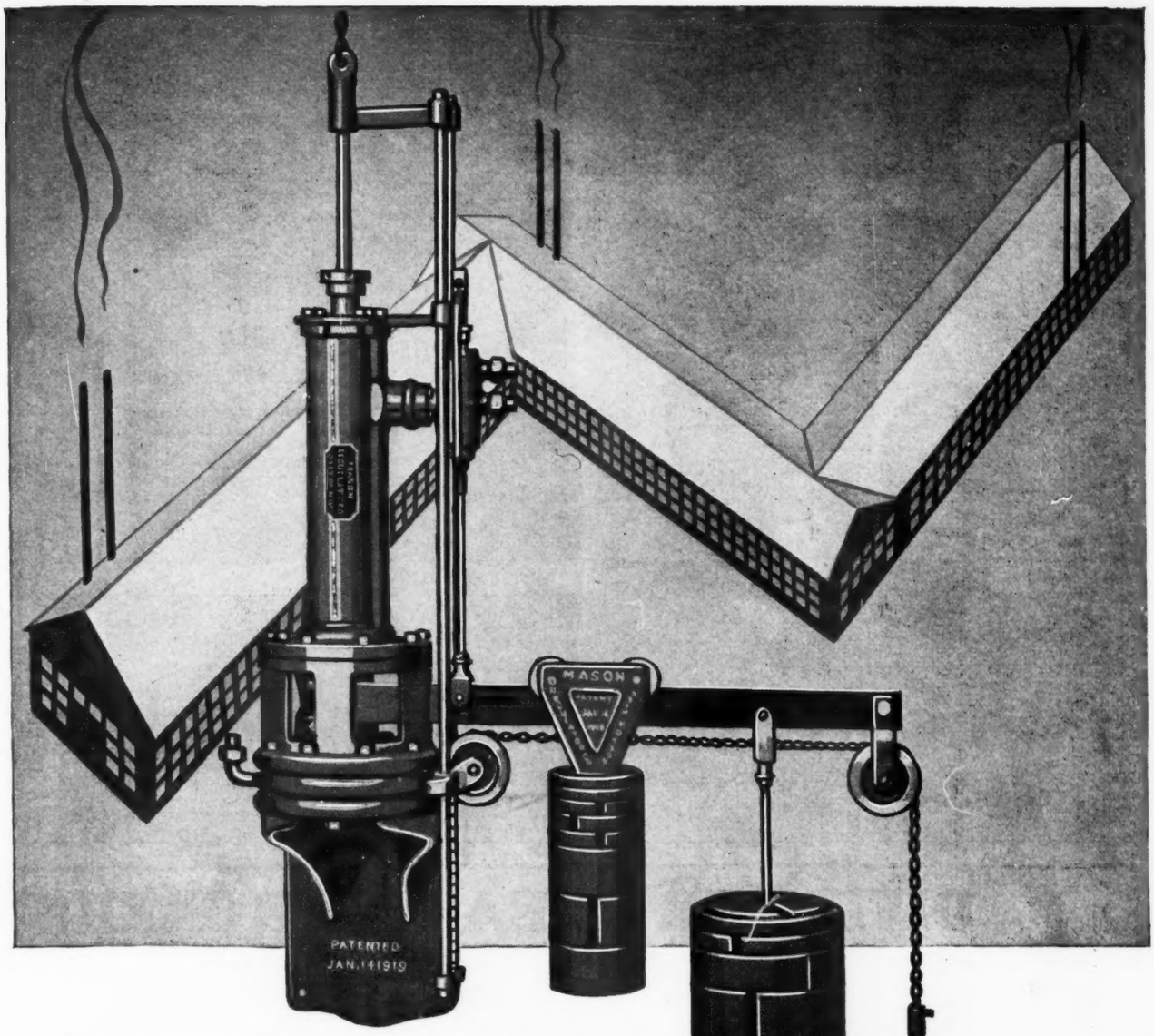

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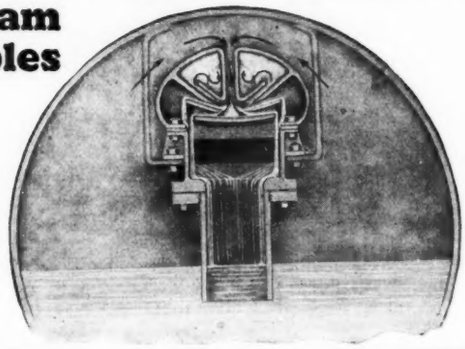

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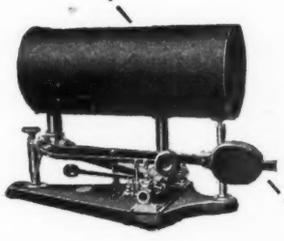

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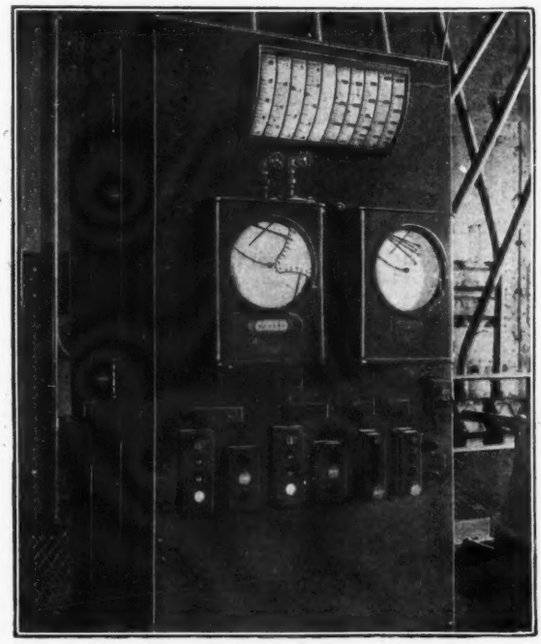

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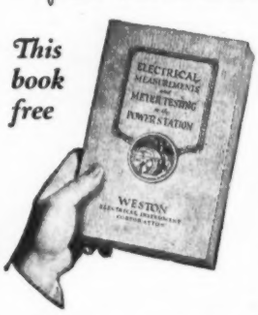

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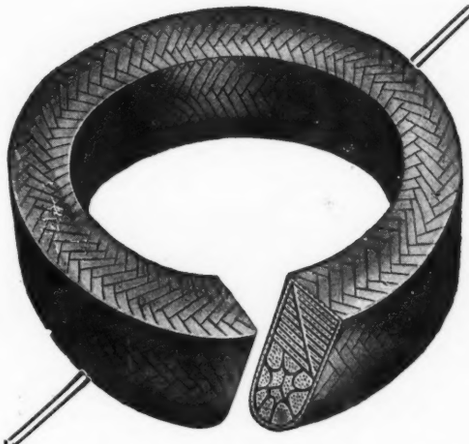


To eliminate friction—use DANIELS P. P. P.

Engineers who have used Daniel's P. P. P. know that it will outlive any other packing. P. P. P. is the original self-setting packing. When pressures fall, it relaxes; then it rests until the rising pressures move the sliding wedges again into position to hold the cylinder steam tight.

Freedom from packing troubles is simply a matter of putting the right kind of packing in the stuffing box in the first place.

Where fibrous packings can be used, P. P. P. is the most efficient. Let us prove it to you. We will send without charge enough to make a thorough trial in your plant. Simply send us description of service and size.

Where sheet packing is required, our EBONITE will give you exceptional service. It withstands the most severe acid tests, high temperatures and pressures. Sample on request. Send for booklet "Some Friction Tests."

QUAKER CITY RUBBER COMPANY

Manufacturers of Mechanical Rubber Goods

Main Offices and Factories: WISSINOMING, PHILADELPHIA

BRANCHES: New York Chicago Pittsburgh San Francisco

MIDWEST

FABRICATED PIPING

Ready to Erect—Including

PIPE BENDS—FLANGED PIPE—WELDED NOZZLE HEADERS
VALVES—FITTINGS—SPECIALTIES

For Any Pressure or Service

MIDWEST PIPING AND SUPPLY CO.
ST. LOUIS

CONNEAUT *Plastic Metallic* **PACKING**

An adjustable metallic packing which does not deteriorate in service, wear or score the rod.

Gives years of service on rods of steam pumps or engines.

Also particularly adapted for high speed rotary pumps.

Forms any size with the fingers.

Manufactured by
The Conneaut Packing Company
Conneaut, Ohio

AMERICAN

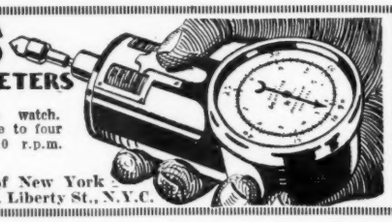
HAND TACHOMETER

(formerly "Columbia") for measuring speeds in r.p.m. Five speed ranges on one spindle. Weighs only 13 ozs. Easily held in hand. Improved patented oiling system. Range—30 to 12,000 r.p.m. *Write for Catalog J-38.*

AMERICAN SCHAEFFER & BUDENBERG CORP.
338 Berry St., Brooklyn, N. Y.
Branches in principal cities

S & S

HAND TACHOMETERS



Accurate as a precision watch. Made in six sizes, of three to four ranges each, up to 16,000 r.p.m. New bulletin on request.

Schuchardt & Schutte of New York
George Scherr Co., 142 W. Liberty St., N.Y.C.

BANROC INSULATION

"A fireproof, permanent, flexible insulation for all temperatures up to 1200 deg. F." Banroc Wool; Banroc Jacket; Banroc Pipe insulation; Banroc Cements (1800 deg. F.); Banroc High temperature Waterproofing. *Send for literature.*

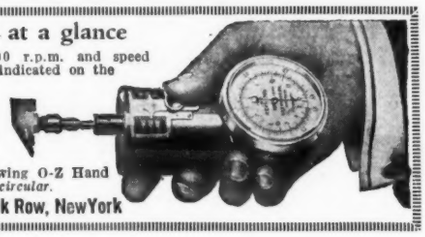
BANNER ROCK PRODUCTS CO., ALEXANDRIA, INDIANA

Shows the speed at a glance

Any speed 30 to 24,000 r.p.m. and speed variations, are instantly indicated on the

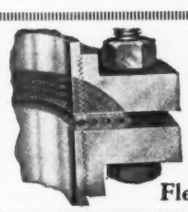
O-Z
Hand Tachometer

No timing necessary "Dead beat," and accurate to within ½ of 1 per cent.



Ask about the chart drawing O-Z Hand Tachograph. *Write for circular.*

O. Zernickow Co., 21 Park Row, New York



"Flexitallic"

a flexible metallic gasket built on correct mechanical principles to withstand modern high pressures and temperature.

Flexitallic Gasket Co., Camden, N. J.

Send for sample of This New and Better Packing

By treating our Style 147 with Luball, a new lubricant, you may now have packing that will give two to five times the service of ordinary packing. Here are some results:

Gas Exhausters: "Were getting 10 days. New packing now in three weeks and still O. K."

Food Products Pump: "Luball does not wash out of packing and mix with material pumped."

Centrifugal Pump: "First packing to give real satisfactory results."

Blowers: "Were getting 3 to 4 days' service. With new Luball packing are getting 37 days' service. Had previously tried everything without success."

For Grummets against Alcohol: "Only packing we have ever seen that stands test of 12 hours soaking in Ethyl Acitate."

"Only satisfactory packing ever used in our main stop and emergency trip valves with pressure 450 lbs. and temperature 750 degrees Fahrenheit."

"On steam and on water rotating shaft no amount of water at any temperature will wash out Luball."

I have nothing to add to the above testimonials, but I would personally appreciate it if you would send for a sample of 147 treated with Luball.

Write, Wire or Telephone

O. J. Garlock

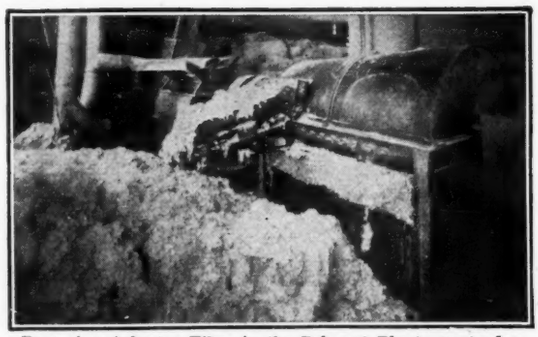
CRANDALL PACKING CO.

PERFECTED PACKINGS FOR EVERY PURPOSE

Palmyra, N. Y., Boston, Chicago, Cleveland, Houston, New York, Pittsburgh, Philadelphia, Kansas City, Mo., St. Louis

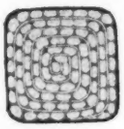
Style 147

Style 147



Preparing Asbestos Fibre in the Belmont Plant—part of a complete modern asbestos textile plant.

Defiance to High Pressures is *built into* this packing



Another Style, wrapped asbestos without core in center.

Semi-Metallic — White Metal and Asbestos cloth.

Center core of round rubber, asbestos wrapped.

Belmont's complete control of every manufacturing process and 35 years of experience enables us to put out High Pressure Asbestos Packings that are most economical in plant service.

Steam, Gas, Air at all pressures are held by No. 20 shown below in ring form. Also in Spiral Form No. 30, and Coil Form No. 40.

Highest grade of packing possible to produce, constructed of Canadian Asbestos, manufactured entirely in our plant, the woven asbestos fabric is held together with heat-resisting rubber. Center is folded instead of braided, and is backed by a heat-resisting rubber cushion.

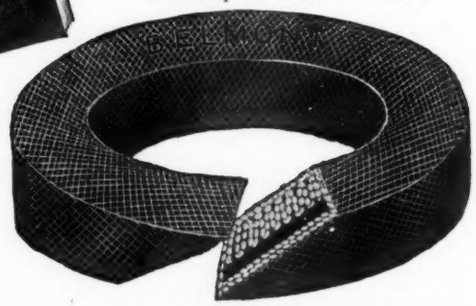
Send for 95 page Belmont Book, 6x8½ in., showing full line.

Belmont Packing & Rubber Co.

Philadelphia, Pennsylvania

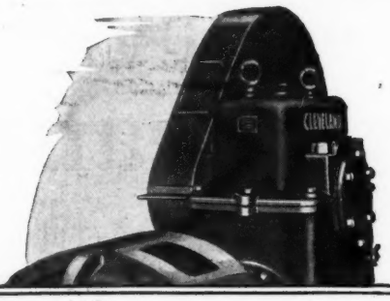
Chicago, Ill., Harris Trust Bldg.
New York, 99 Chambers St.,
Agencies in principal cities

Live Representatives Solicited

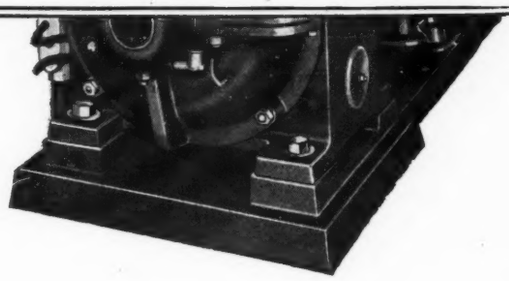


BELMONT PACKINGS

[Why we can build more service into Belmont Packings — No. 2 of a series]



-dependable power transmission-



How much will it save in your plant?

Cleveland worm gear speed reduction units save through reduced costs for maintenance, repairs, and replacements.

A further saving is made by insurance against breakdown delays—which may cost many times as much as the installation of a Cleveland drive.

These items represent ultimate economy in plant operation and warrant careful consideration of drives with the high quality of the Cleveland speed reduction units.

Such savings are not affected by means of heavy machinery, increased space, or low efficiency. The Cleveland drive is well-proportioned, compact and efficient.

Cleveland worm gearing is the highest development of the industrial worm gear. It has been manufactured continuously for over fifteen years and thousands of successful installations have been made in American and Canadian plants.

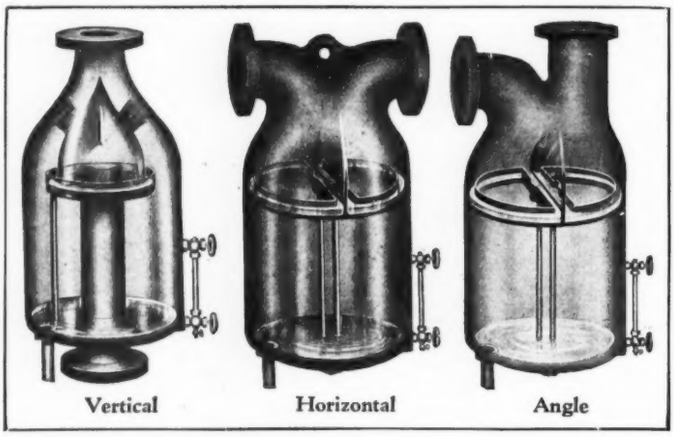
Cleveland TRADE MARK C W & G Co WORM GEAR REDUCTION UNITS

The complete line of standardized Cleveland Worm Gear Reduction Units is described in Bulletin No. 106. Standard units for horizontal or vertical shafts and for overhung loads, as well as double-reduction drives. May we send you a copy?

Cleveland Worm & Gear Company

3295 East 80th St. **Cleveland, Ohio**

"America's Pioneers in Efficient Worm Gearing"



Dry Steam

carries more power to the prime movers

HOPPES Steam and Oil SEPARATORS

operating principle insures dry steam and clean steam under all conditions.

All water, liquids and oil creeping along the sides of the pipes are intercepted and caught by gutters, partly filled with water.

The moisture is caught in gutters or troughs that surround a central conical surface and by the impingement of the steam upon the surface of the water in the bottom of the receiver.

Hoppes Steam and Oil Separators are made in all required sizes and in vertical, horizontal and angle types. Special separators built to order.

The Full Hoppes line consists of feed water heaters and purifiers, deaerating feed water heaters, V-notch Meters, combined feed water heaters and meters, steam separators, oil eliminators and exhaust heads.

Write for the Hoppes Catalog.

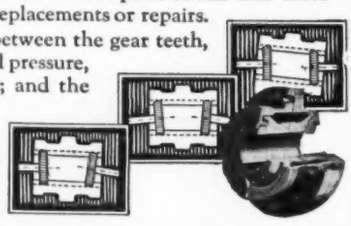
THE HOPPES MANUFACTURING CO. 19 Larch St., Springfield, Ohio

FAST'S COUPLING Stops Replacements

THE REASON is the ABSENCE of flexible materials in Fast's flexible coupling design. Instead, two spur gears, one on each shaft end, are completely and continuously meshed in oil with the internal gears of a floating sleeve. The shafts and sleeve turn noiselessly as one unit, allowing free angular and lateral movement.

So there is nothing to be continually bent or compressed. Nothing to fatigue and crystallize. No flexible bushings. No pins. No springs. No discs or grids or any other flexible parts to fail and cause shut-downs for replacements or repairs.

Instead, oil between the gear teeth, under centrifugal pressure, carries the load; and the coupling will last as long as the connected machines.



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200 Scott Street · BALTIMORE, MD.

Write today for free **BOOK**

FRANCE

Metallic Packings of the Better Class

Ideal for superheated or saturated steam, ammonia, air or gas for all pressures and operating conditions. Last 5 to 25 years. Sold on approval.

Write for catalog and list of users.

FRANCE PACKING COMPANY
6600 Tacony St., Philadelphia, Pa.

METALLO GASKETS

Indestructible asbestos cord laid in circular groove by protecting cover of copper is the basis of the Metallo Gasket—a gasket that is making an enviable record under the severest conditions. Write for ILLUSTRATED catalog and free samples.

METALLO GASKET COMPANY
New Brunswick, N. J.

MAGNOLIA ANTI-FRICTION METAL

For Sale by Dealers Everywhere

Send for free Booklet

Magnolia Metal Co., 75 West St., New York

Nuttall Gears Pittsburgh

How other engineers handle tricky heating and ventilation problems; how they solve them—

AN American edition of this famous work, adapted to American practice, translated from the Seventh German Edition of Heizungs- und Lüftungstechnik by Dr. H. Rietschel, late Professor of the Technical University of Berlin —Charlottenburg, and C. W. Brabbée.

The book discusses thoroughly those phases of the design of apparatus which apply to heating installations, giving the architect and engineer the information needed to appraise and criticise the value of heating and ventilating equipment of various types.

Rietschel-Brabbée's

Heating and Ventilation

A Handbook for Architects and Engineers

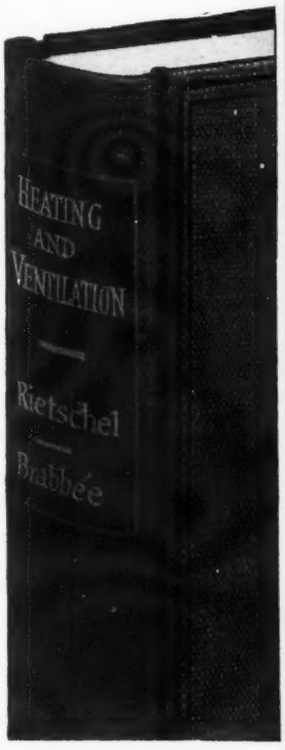
By Charles W. Brabbée
Director of the Brabbée Laboratory, American Radiator Company

Translated and adapted to American Practice from the Seventh German Edition of Rietschel-Brabbée Heizungs- und Lüftungstechnik

352 pages, 6x9, 186 illustrations

7 folding charts in pocket of back cover, $4.50 net, postpaid.

THE book not only furnishes architects and engineers with a clear view of the problems to be solved, but supplies the necessary equipment for rapid computation of design. A pocket is affixed to the inside back cover containing 7 charts covering—Gravity Hot Water Heating System Temperature Drop—Forced Hot Water Heating Systems — High Pressure Systems—Vacuum Steam—Low Pressure Steam—Air Heating and Ventilating Systems—Equivalent Diameters and Cross-sectional Areas for Rectangular Ducts.



The book covers in detail such topics as:

—fireplaces;
—conduit wiring systems;
—oil stoves;
—gas heating;
—medium-pressure hot-water heating systems;
—high-temperature hot-water heating;
—warm-air heating;
—exhaust heat ventilation;
—vacuum heating systems;
—warm-air heating systems;
—heat standard, humidity standard, carbon dioxide standard, pressure standard;
—filters;
—apparatus for humidifying, washing, and drying air;
—etc., etc., etc.

See the book for 10 days FREE

McGraw-Hill Book Co., Inc., 370 Seventh Avenue, New York.

You may send me on 10 days' approval **Rietschel-Brabbée's Heating and Ventilation, $4.50 net, postpaid.** I agree to remit for the book or return it postpaid within 10 days of receipt.

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GARLOCK
TRADE MARK

1500° Fahrenheit

A Shredded Metal Packing That Will Stand High Temperatures

ON account of the developments created in the Power Field to produce the highest economies in prime movers, we find ourselves in the age of extremely high temperatures and pressures.

The Research Engineering Department of The Garlock Packing Company have been working hand in hand with the technical staffs of equipment manufacturers to design a packing to meet this new existing condition.

In this we have been successful and we are now offering to the trade Garlock-934 and Garlock-935 High Temperature Shredded Metal Packing. These mechanical packings are manufactured from high heat resisting metal floss bonded under pressure and impregnated with graphite. They will effectively pack against the highest of pressures and withstand heat up to 1500° Fahrenheit.

GARLOCK-934

Garlock-934 is square in cross section and furnished in ring form. Recommended for service on Reciprocating Pistons and Valve Rods.

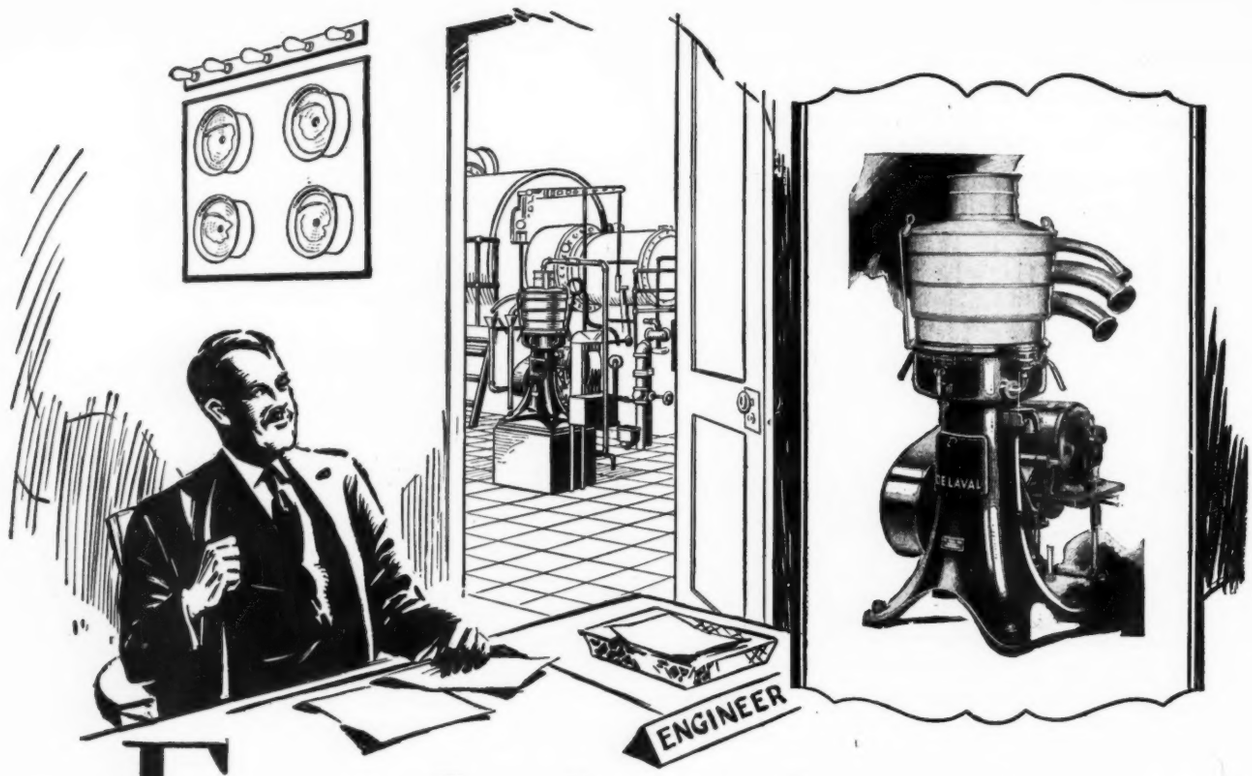
GARLOCK-935

Garlock-935 is furnished in sets in ring form. Each and every ring is beveled so as to fit into each other. All sets are made with bevelled end rings of superheat solid metal. Recommended for Piston Rods, Plungers and Valve Stems working against high temperatures and pressures. Also gives excellent service on Rods and Plungers of Hot Oil Pumps.

The Garlock Packing Company
Palmyra, New York

Sales Offices and Warehouses in all Principal Industrial Centers

The Standard Packing of the World



Everybody is happier with Clean Oil

Chief engineer or oiler, superintendent or chairman of the board, all are benefited by the installation of a De Laval Oil Purifier to keep lubricating oil clean.

When dirty oil causes bearing trouble, as it inevitably does, the operating force works overtime and the cost of operation is increased. The chief engineer and laborer are alike denied their days off, while hundreds, perhaps even thousands, of dollars which might go into dividends are expended in making repairs or lost through a decrease in plant production.

Clean oil guards against bearing trouble. Alone and unaided, the De Laval Oil Purifier has cured many hot bearings which made it impossible for a turbine or a Diesel engine to carry full load. It has decreased the amount of work necessary to proper bearing maintenance as much as 80%. It has enabled units with bad water leaks to carry full load for as long as 16 months without injury of any kind.

These are just some of the ways in which De Laval Oil Purifiers have proved themselves the most profitable small investment in the power plant. As a rule, the saving of oil alone quickly pays for the machine, thus satisfying the financial management as to its investment value.

Write today for Bulletin 106-P giving full details.

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 600 Jackson Blvd., Chicago

DE LAVAL PACIFIC COMPANY,
61 Beale St., San Francisco

ALFA-LAVAL CO., Ltd., 34 Grosvenor Road, London, S. W. 1.

DE LAVAL OIL PURIFIERS

Types for Lubricating Oil and Insulating Oil

Dixon's Waterproof Greases

Expensive material-handling machinery in your yards needs plenty of good grease. And, it needs protection—especially of those parts which must be greased—cables, chains, exposed gearings, racks, bearings, pumps, and the like.

Men who have charge of the operation of this kind of equipment find it good practice to do all such greasing with Dixon's Waterproof Graphite Grease.

There is good reason for this. In addition to its excellent lubricating qualities, this grease possesses remarkable adhesiveness. It cannot be washed off—even by running water, sea water or sulphurous mine waters. It cannot gum or become rancid, and as a rust preventive it is unsurpassed.

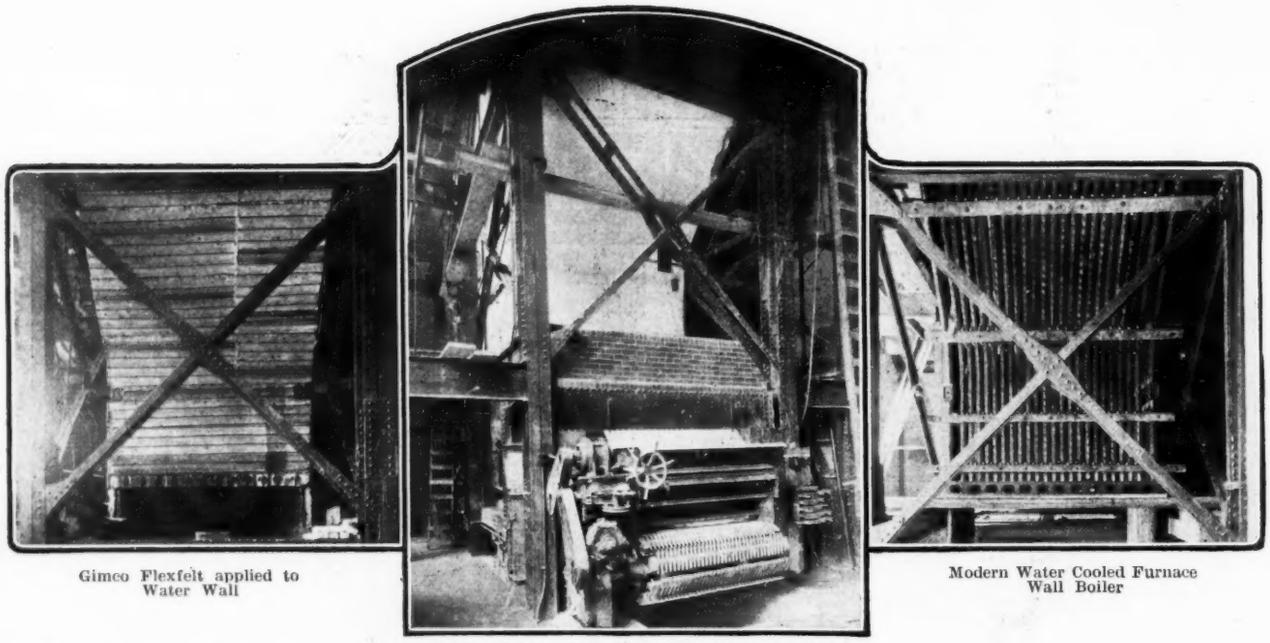
Better lubrication results from less frequent greasing with:
DIXON'S Waterproof Grease

Order a 5 lb. can and try this out for yourself
Bulletin B-94 and quotations on request.

Joseph Dixon Crucible Company

Jersey City D X N TRADE MARK **New Jersey**

Established 1827



Gimco Flexfelt applied to Water Wall

Gimco K-14 and Hard X Insulating Cements, applied over Flexfelt showing finished coat

Modern Water Cooled Furnace Wall Boiler

Here is Real Insulation!

Can be had in any shape, size or thickness—rigid or flexible.

Flexfelt, the supreme insulation for boilers, hot air ducts and piping, is made from Gimco Rock Wool, containing 90% dead air spaces, and felted between metal fabrics. Flexfelt will not calcine, disintegrate or settle under 1250° F. The U. S. Bureau of standard rates rock wool as the most efficient fireproof chemically stable insulator.

Thousands of power plants use Flexfelt with great success. It's economical!

Send drawings or specifications for quotations. Bulletin No. 400 is yours on request.

Gimco Flexfelt, No. 409

Gimco Pipe Covering, Style No. 201

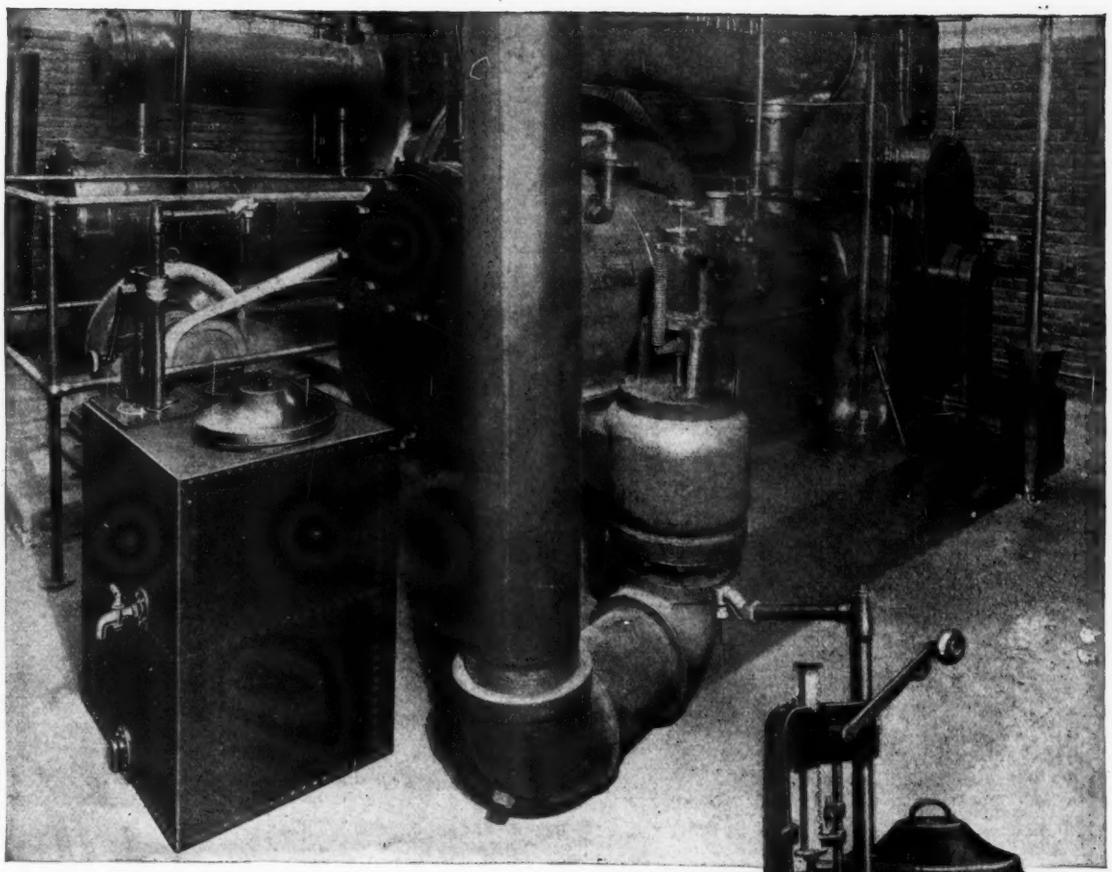
Gimco Rock Wool is available in the following forms and shapes:

Flexfelt—standard shapes or cut to fit.
Gimco K-14 Insulating Cement.
Gimco Insulating Brick.
Gimco Rock Wool Insulating Block.
Gimco Rock Wool Cork for Cold Storage Insulation.

GENERAL INSULATING & MFG. CO.
Alexandria, Ind.

Offices in Principal Cities

FLEXFELT



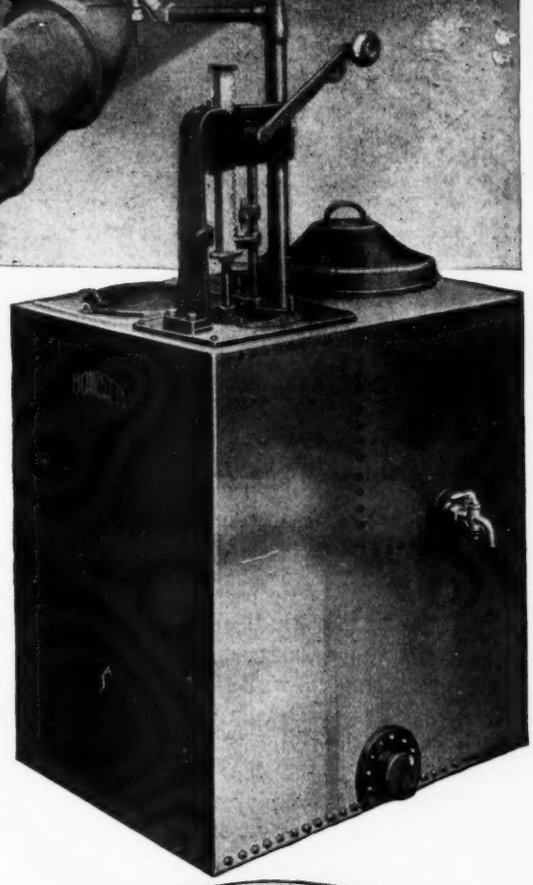
Complete Type B Bowser System for cleaning and renovating oil—a small but efficient outfit for filtering and storing oils.

"Waste not, want not"—
it's still true!

LUBRICATION is by *clean* oil—dirty oil wears out bearings, causes more rapid depreciation and leads to trouble.

To keep oil clean, to prevent loss and waste, filter it through a Bowser batch filter. Such a system as is shown is for the smaller quantities, but it is just as efficient as the larger continuous systems. For compressors, the smaller steam turbines, enclosed crankcase steam engines, gas engines, etc., this outfit is recommended.

It will serve, too, for the oil used to bath-lubricate the bearings and gears of many machine tools. A Bowser wheel-tank is frequently used to advantage with this filtering and storage unit. Ask about Type B, if you would like to have clean oil, at minimum cost.



BOWSER
ESTABLISHED 1885

COMPLETE SYSTEMS FOR HANDLING LUBRICANTS—RECEIVING, STORING & DISPENSING, DISTRIBUTING & SERVING, APPLYING, RECLAIMING & FILTERING

S. F. BOWSER & COMPANY, Inc.
COMPLETE LUBRICATION EQUIPMENT
1317 Creighton Avenue
FORT WAYNE, INDIANA

BERNITZ
SUPER BLOCKS

U. S. Patents
1,393,606
1,621,267
1,627,349
and applications pending.
Also foreign patents.

save

SAVING dollars and cents on labor and setting maintenance and eliminating boiler outage, due to clinker-adhesion and furnace wall failures, is exactly what *Bernitz* Carborundum Super Blocks are doing in hundreds of industrial and public utility power plants. *Bernitz* Linings are positively clinker-proof and "long-life" even under the most rigorous and destructive furnace conditions.

Upwards of three years without repairs is common service for *Bernitz* equipped walls. Why not let *Bernitz* Furnace Walls *save* for you. (Note both perforated and blank face blocks.)

"A *Bernitz* type for every need" including water walls, ventilated pulverized fuel furnace walls and floors. Let us know your particular furnace wall problem and we shall gladly submit our recommendations to you.

BERNITZ FURNACE APPLIANCE COMPANY

MAIN OFFICE:
80 Federal Street
Boston, Mass.

LONG LIFE TRADE MARK BERNITZ METHOD

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Fidelity-Philadelphia Trust Bldg., Philadelphia
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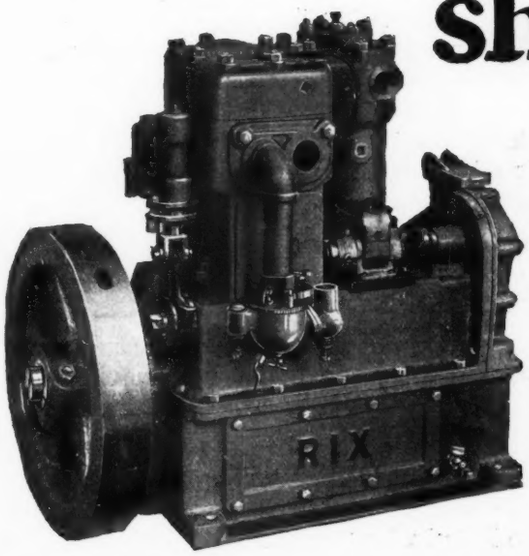
Pittsburgh Cleveland Atlanta New Orleans St. Louis Salt Lake City San Francisco Seattle

Bernitz Carbofrax Super Blocks are Manufactured exclusively for us by THE CARBORUNDUM CO., of PERTH AMBOY, N. J.

Sure as shootin'-



What more serious dilemma than to be without power? Can you afford to depend upon *Diesel* power without being *sure* you can *start* the Diesel? Why take chances when it is so easy to install a RIX Auxiliary air STARTER and be absolutely sure? This RIX is a new highly improved model perfected in half a century's compressor engineering—*RIX since 1877*. Simple, compact, direct-connected, and—*sure as shootin'*. Single and 2-stage types, pressures up to 1500 lbs. Write for Bulletin 6-F.

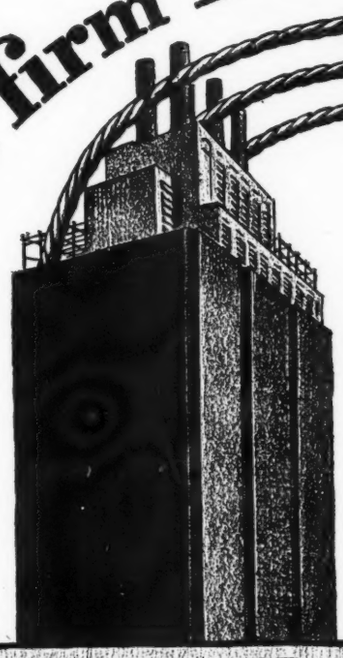
COMPRESSED AIR MACHINERY — R I X — SAN FRANCISCO LOS ANGELES

Since 1877

THE RIX COMPANY, Inc., 400 4th St., San Francisco
Los Angeles, Portland, Seattle

RIX [direct-connected auxiliary air] STARTER

A firm foundation-!



The only safe foundation for a public utility is public good will.

The only basis for good will is good service. Only with reliable equipment is good service possible.

Only with dependable brushes can generators, rotaries and motors give reliable service.

For brushes on which they can depend absolutely, many utilities turn to Speer.

To see what Speer brushes might do for you, write for a Speer Brush Data Form for each of your machines. How many?

SPEER CARBON COMPANY, SAINT MARYS, PA.

SPEER CARBON BRUSHES

2567

When Choosing Floor Grating . . .
Consider Ease of Installation

Write for a copy of the new Mitco booklet

FURNISHED in a number of types and depths in panel widths up to 38 in., with openings of any size or shape, Mitco Interlocked Steel Floor Grating can also be supplied, without additional cost, in panels of greater widths, where special conditions must be met.

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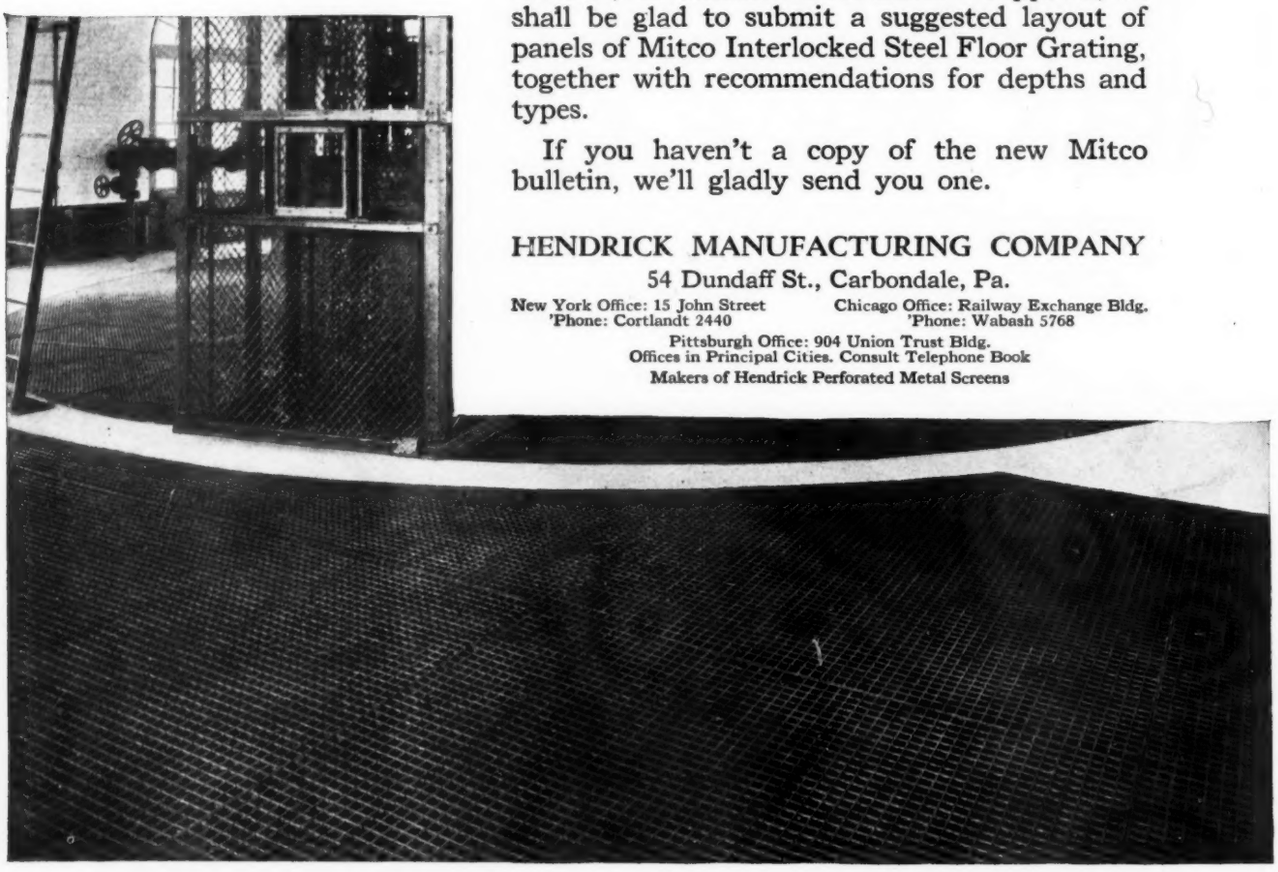

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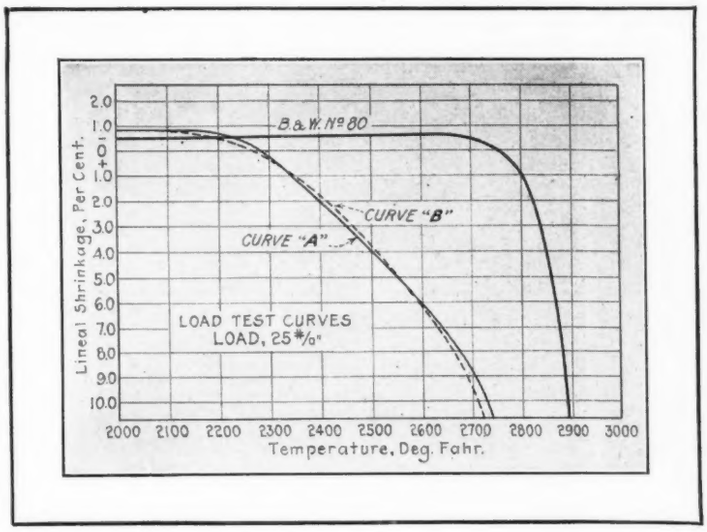

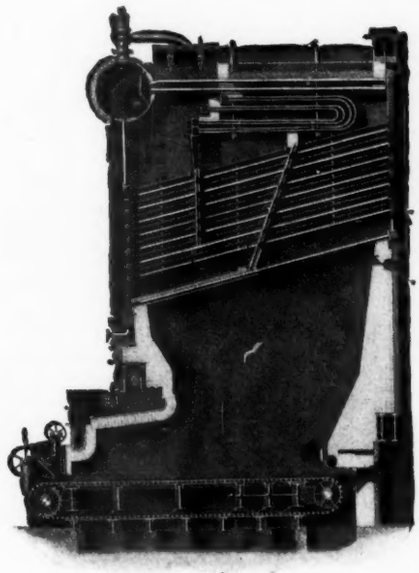

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The high settings now commonly designed for modern boilers operating at high ratings, especially when fired by pulverized coal, impose an exceptional weight on the furnace lining, usually in the hottest portions. The load caused by the weight of the brickwork structure alone amounts to about one pound per square inch per foot of wall height.

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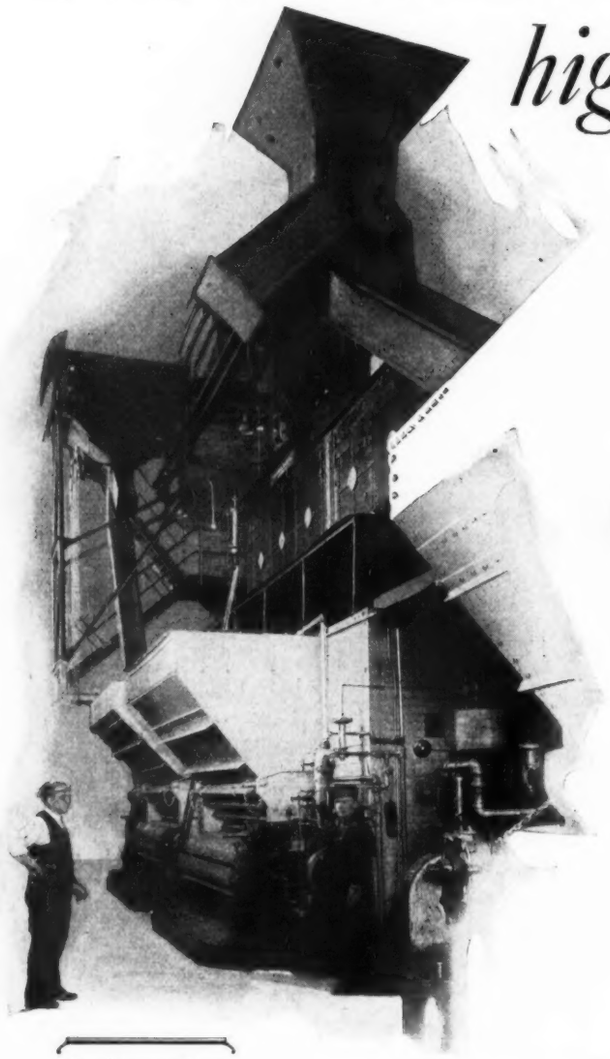

There you will invariably find the boiler furnaces lined along the clinker line with

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CLINKER is admittedly the cause of lessened combustion efficiency and the high maintenance cost of firebrick settings.

Carborundum Brick along the fire line eliminates the clinker nuisance. The high refractoriness of Carborundum precludes the possibility of the brick softening under boiler temperatures. Therefore clinker cannot fuse to the wall where they are used.

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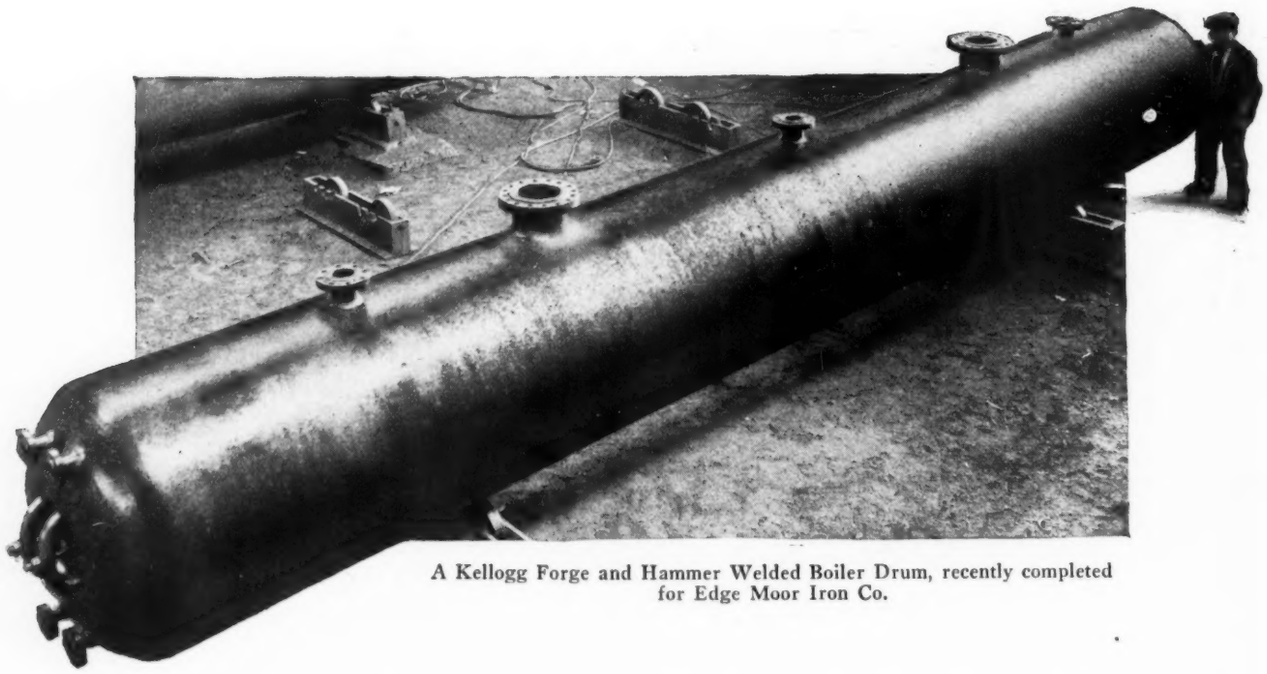

A Kellogg Forge and Hammer Welded Boiler Drum, recently completed for Edge Moor Iron Co.

A Forge and Hammer Welded Boiler Drum— 4 feet I.D.— 31 feet long

THIS boiler drum is one of a large order for installation in the Oklahoma City plant of the Oklahoma Gas and Electric Co. operated by H. M. Byllesley & Co. engineers and managers. This Forge and Hammer Welded Boiler Drum designed in accordance with A.S.M.E. Boiler Construction Code is 48 I.D., 31 ft. long, and the shell is 1¼ in. thick. It is fitted with two 10 in. fluid type, forge welded nozzles and three 4½ in. expanded and autogenously sealed nozzles. Heads are ellipsoidal in shape and equipped with a 12 in. x 16 in. standard boiler manhole, two 1½ in. and two 2 in. expanded and autogenously sealed nozzles. Working pressure 350 lbs. Test pressure 525 lbs. Approximate weight 23,300 pounds.

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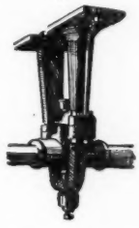

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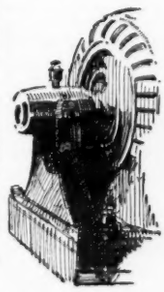

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1—**Fleming & Harrisburg Steam Engine** Serial 4675, Left Hand, 140 hp., direct connected to 100 kw., 2400 volt, Westinghouse A.C. generator, 3 phase, 60 cycle, 225 r.p.m., Serial 1469328, with exciter .....Divernon, Ill.

1—**Ideal Engine** Serial 14206, Right Hand, 160 hp., direct connected to Westinghouse generator 125 kw., A.C., 60 cycle, 3 phase, 2300 volt, 225 r.p.m., with exciter.....Divernon, Ill.

1—**Direct connected synchronous motor generator set** with exciter direct connected to generator end of shaft, Westinghouse synchronous motor 450 hp. output, 4000/2300 volts, 60 cycle, 365 amps., per phase, 900 r.p.m., Serial 1108617, Westinghouse generator 300 kw., 600 volt, 500 amp., 900 r.p.m., Serial 1108621, Exciter No. 70L, Type SK, Compound wound, 7 kw., 125 volt, 56 amps, D.C., Serial 1108613. This set has complete control equipment for starting either from A.C. or D.C. ends. The outfit is of a heavy duty type. .....Charleston, Ill.

1—**Rice & Sargent Heavy Duty Cross Compound Non-releasing Corliss Valve Engine,** Cylinders 20 and 40 x 42, direct connected at 106 r.p.m., with 625 kva. Westinghouse Revolving Field Engine Type Generator, 60 cycle, 3 phase, 2300 volt, A.C. Overall floor space 27-ft. x 27-ft. .....Mattoon, Ill.

1—**Quincy Cross Compound Corliss Engine** direct connected to Western Electric generator Serial 25531, Type L-8-225 kw., D.C., Speed 150 r.p.m., 390 amps., 525 volts no load, 575 volts full load. .....Anna, Ill.

1—**Erie City Engine** 14 x 16 flywheel governor Serial 19532 direct connected to 150 kw., Westinghouse Alternator Serial 207166, 60 cycle, 2300 volt, 375 A. per terminal, 3 phase, 257 r.p.m., with 10 kw. belt driven Westinghouse exciter 125 volt, 80 amps., 125 r.p.m. .....Anna, Ill.

1—**Ball Engine** 12 x 18 Serial 4460 direct connected to Wood A.C. generator Serial P-115856, Type T.R.E. Class 28-105-257, Form E, amps. 264, Speed 257, 2300 volts with 10 kw., 125 volt Woods Exciter driven from flywheel .....Anna, Ill.

1—**Chuse Left Hand Heavy Duty Non-releasing Corliss Engine,** Cylinder 22 x 28, equipped with massive balance wheel Serial 992, direct connected to 375 kw., G. E. Engine Type Alternator, Serial 559281, Type A.T.B.-48-375-150, Form E, 150 r.p.m., complete with 14 kw., 750 r.p.m., G. E. Inter-pole exciter belted from main shaft. Installed 1909. Overall 16 x 20....Mounds, Ill.

1—**Chuse Left Hand Non-releasing Heavy Duty Corliss Engine,** Cylinder 23 x 30, Serial 1257, direct connected to 360 kw., G. E. Engine Type Alternator, Class 48-450-150, Form E, 150 r.p.m., complete with 15 kw., 525 r.p.m., MP6 Exciter. Installed 1916. Overall 15 x 21.....Mounds, Ill.

1—**G. E. Horizontal Turbo-Alternator,** 500 kw., 3600 r.p.m., 80% Power Factor, 2300 volt, 3 phase, 60 cycle, generator Serial 482636, Turbine Serial 8080, Exciter Serial 336555. This turbine is complete with condenser and all auxiliaries. The generator includes Westinghouse 3 section panel with all auxiliaries .....Paris, Ill.

1—**100 kw. Westinghouse Generator** 4 volt inter-pole, 550 volt, D.C., 1120 r.p.m., self contained on sub-base, 150 hp., Type C.C.L. motor, 60 cycle, A.C., 3 phase, 2300 volts.....Mattoon, Ill.

1—**300 kw., Westinghouse 550 volt, D. C., Interpole Generator,** self contained on sub-base at 600 r.p.m., with 450 hp. Westinghouse synchronous motor, 60 cycle, A.C., 3 phase, 2300 volts. .....Mattoon, Ill.

1—**150 kw., Electric Machinery Co. Revolving Field Engine Type Alternator,** 60 cycle, 3 phase, 2300 volt, Serial 402511, direct connected at a speed of 120 r.p.m., with Murray left hand heavy duty Tandem Compound Corliss Engine, Cylinders 10 and 20 x 30, Serial 3603, Overall 27-ft. x 13-ft. .....Beardstown, Ill.

1—**250 kw., Electric Machinery Co. Revolving Field Engine Type Alternator,** 60 cycle, 3 phase, 2300 volt, Serial 402494, direct connected at a speed of 120 r.p.m., with Murray right hand heavy duty Tandem Compound Corliss Engine Double Eccentric Bored Guide, Cylinders 12 and 26 x 36, Serial 3602, Overall 33-ft. x 15-ft., complete with Band Exciter 125 volts, 870 r.p.m., Control Panel.....Beardstown, Ill.

All of this equipment was in operating condition when removed from service and is available for inspection at the locations mentioned. Prices and terms upon application.

CENTRAL ILLINOIS PUBLIC SERVICE CO.

SPRINGFIELD, ILLINOIS

D. R. TRUAX, *Purchasing and Stores Agent*

MOTOR BARGAINS

NEW AND USED

EVERY motor sold is guaranteed. Write for our low prices on your requirements.

SLIP RING MOTORS

Hp.	Make	Ph.	Cy.	Volts	Rpm.
300	Allis-Chal.	3	60	220/440	870
200	Fair.-Morse	3	60	220/440	600
175	Allis-Chal.	3	60	550	600
100	Westg. (C.W.)	3	60	550	600
100	Westg. (C.W.)	2	60	220	600
100	Westg. (C.W.)	3	60	220/440	600

Other slip-ring motors down to ½ hp.

SQUIRREL CAGE MOTORS

150	G. E.	3	25	440	375
150	G. E. (K.T.)	3	60	2200	870
100	Cr.-Wh.	3	60	220/440	1750
75	Cr.-Wh.	3	60	220/440	1160
50	Gen. Elec.	3	60	220/440	900

Other squirrel cage motors down to ¼ hp.

DIRECT CURRENT MOTORS

All 220 volts-230 volts

Hp.	Make	Speed
120	Sprague (C)	450/900
100	Sprague (C)	550/1100
60	Westg. (S)	920
50	Westg. (S)	750/955

Other D.C. motors down to ¼ hp.

Write for complete stock list.

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Used and Rebuilt Engine Generator Sets, Turbo Generator Sets, Motors, Rotary Converters, Generators, Motor Generator Sets, Engines, Boilers, Steam and Electric Machinery of all kinds also Machine Tools. Send for our new machinery list. Yours for the asking.

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POWER APPARATUS

1—3,000 kw. G. E. Turbo.
2—1,000 kw. G. E. Turbo.
1—780 kw. Westgh. Turbo.
2—600 kw. New G. E. Turbo.
1—300 kw. Westgh. Turbo.
2—300 kw. G. E. Turbo.
1—90 kw. Terry-Allis.
1—62½ kw. Westgh. Turbo.
3—85 kw. Allis-Chalmers. to Diesel Engines.
100 kw., 125v. D.C. to Ames.
150 kw., 125 v. D.C. to Ames Unaflow.
300 kw., 250 v. D.C. Westgh. Turbo.
50 kw., A.C. Ames.
125 kw.,A.C. Hamilton.
125 kw., A.C. Harrisburg.
160 kw., A.C. Ames.
156 kw., A.C. Skinner Unaflow.
185 kw., A.C. Skinner Unaflow.
312 kva., NEW General Elec.

Turbo Generators, Various Sizes; Also large stock Transformers, Engine Driven Units, Motor Generators, Motors, Dynamos of all descriptions.

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2—100 HP. Loco. type 125 lb. pres.
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1—100 HP. Vertical 100 lb. pres.
1—200 HP. Lebanon H.R.T. 150 lb. pres.
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Also other sizes in stock.

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A. C. Units

800 KVA. G.E.—Erie Ball, 4 v.
750 KVA. (2) G.E. — Curtis Turbines (bleeder).
625 KVA. G.E.—Curtis Turbine (bleeder).
750 KVA. G.E.—30x34 Ames Uniflow.
627 KVA. G.E.—26x32 Chuse, 4 v.
500 KVA. G.E.—25x30 Erie Ball, 4 v.
400 KVA. Ridgway—26x24 Ridgway.
375 KVA. G.E.—Turbine (bleeder).
375 KVA. Wghse.—Turbine (back pressure).
325 KVA. G.E.—Skinner Uniflow.
300 KVA. G.E.—20x36 Allis Corliss.
250 KVA. Al.-Chal.—19x24 Ames Uniflow.
150 KVA. G.E.—16x16 Ames Uniflow.
125 KVA. G.E.—Skinner Uniflow.
62½ KVA. G.E.—Skinner Uniflow.

Special

375 KVA Ridgway, 3 phase, 60 cycle, 440/220 volt Alternator (can change for 550 volt) direct connected 20x24 Ridgway 4 valve non-releasing, side crank Engine; with Exciter also complete Switchboard. Three years service; like new. Still on foundation. Price $3,750 on cars New York.

Boilers

(ASME)

HP.	Make	Pressure
627	Sterling	160 lbs.
548	B. & W.	225 lbs.
517 (4)	Erie City	200 lbs.
500 (2)	Heine	160 lbs.
500 (2)	Keeler	200 lbs.
500 (4)	B. & W.	200 lbs.
468 (3)	Sterling	160 lbs.
337 (2)	Heine	180 lbs.
317	Heine	225 lbs.
302 (2)	B. & W.	160 lbs.
250	Heine	160 lbs.
205 (4)	Heine	170 lbs.

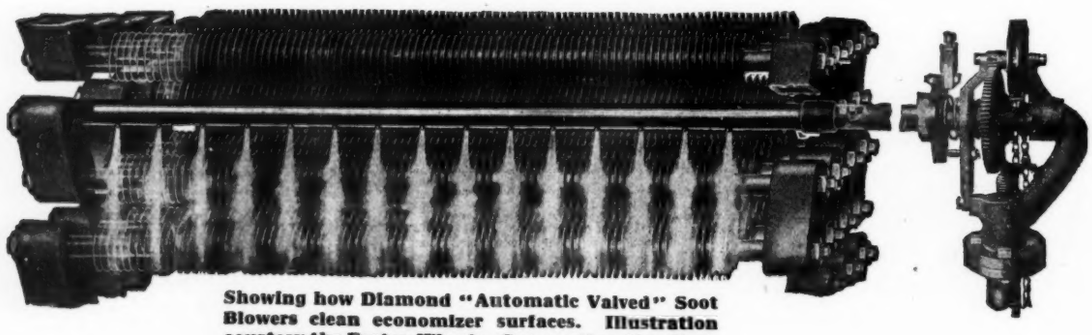
POWER PLANT EQUIPMENT COMPANY, Inc. 39-41 Cortlandt Street New York City, N. Y.

DIAMOND SOOT BLOWERS FOR ECONOMIZERS

ECONOMIZERS are installed to save fuel and increase boiler capacity. They do this economically and efficiently—pay substantial returns on the investment—when their heating surfaces are kept free from soot and ash deposits.

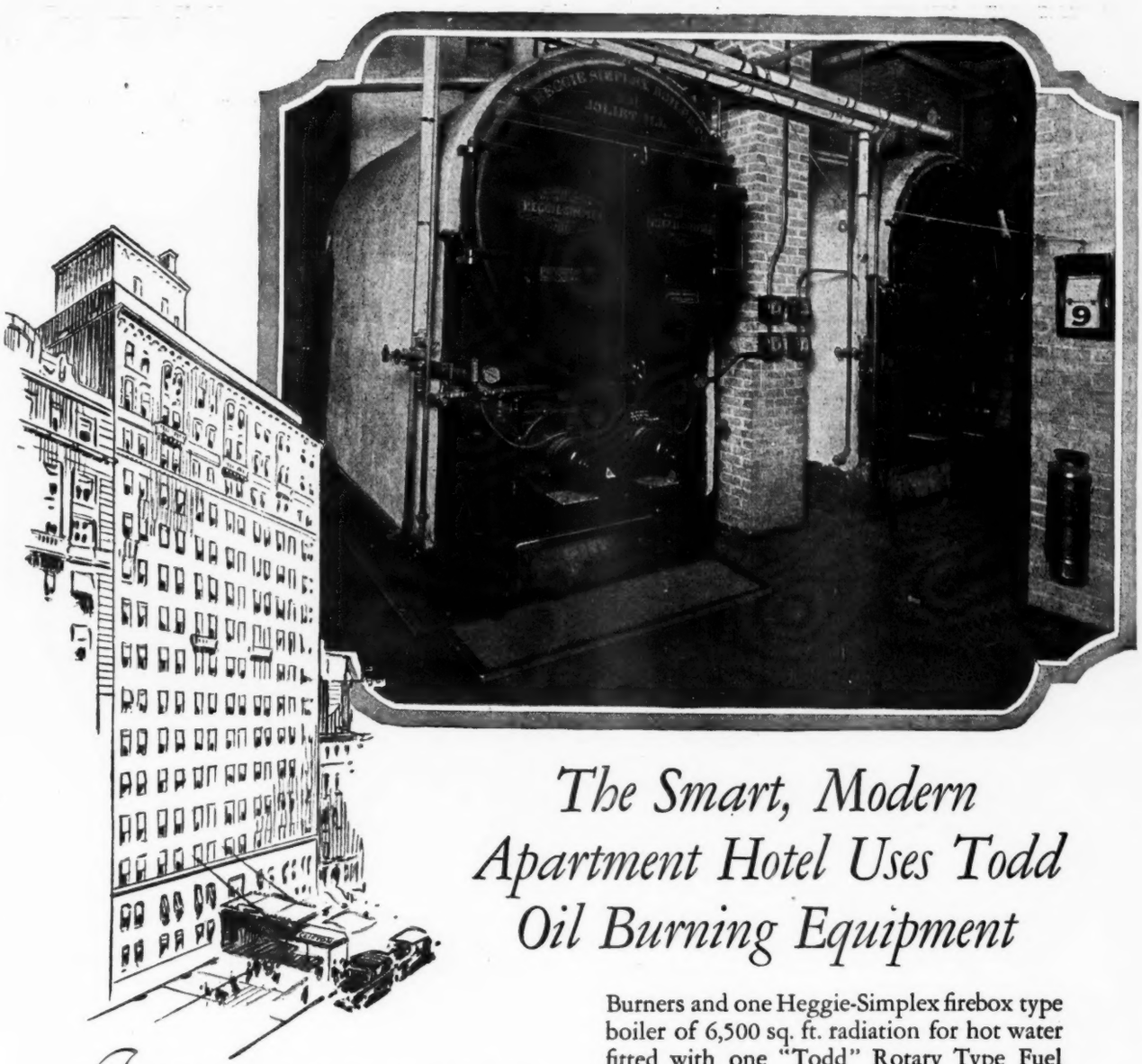
For this purpose the most effective means of cleaning is the Diamond "Automatic Valved" Soot Blower—a fact recognized by leading economizer manufacturers.

Write us regarding soot blowers for economizers.



Showing how Diamond "Automatic Valved" Soot Blowers clean economizer surfaces. Illustration courtesy the Foster-Wheeler Corporation, New York

DIAMOND POWER SPECIALTY CORPORATION
DETROIT, MICH



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IT is significant that the smart, well regulated apartment hotel serving a clientele that demands and receives the most perfect type of service such as the Hotel Clifton at 127-137 West 79th Street is heated with "Todd" Oil Burning equipment.

This outstanding example of New York's smartest apartment houses has a heating plant system of two Heggie-Simplex firebox type boilers of 14,500 sq. ft. radiation each; each fitted with two "Todd" Rotary Type Fuel Oil Burners and one Heggie-Simplex firebox type boiler of 6,500 sq. ft. radiation for hot water fitted with one "Todd" Rotary Type Fuel Oil Burner.

"Todd" Rotary Fuel Oil Burners produce an intensely hot, soft flame without smoke trouble, up to high boiler ratings and are scientifically designed to completely atomize the heaviest fuel oil.

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Foot of 23rd Street, Brooklyn, New York

TODD

WHAT AND WHERE TO BUY

Equipment, Apparatus and Supplies Used in the Power Plant Field with Names and Addresses of Manufacturers and Distributors Whose Advertisements Appear in This Issue

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Conveyors, Belt
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Industrial-Brownhoist Corp., Cleveland

Allis-Chalmers Motor and Texrope Drive operating Deister-Overstrom Concentrator, Alliance Mining Co., Kaska, Pa.

Unusually severe conditions met with complete satisfaction

THE intermittent shock loads of concentrators are especially tough on motors coupled through inflexible drives. Hour after hour the motor must undergo constantly repeated shocks. This necessitates frequent inspection of the motor and also shortens its life considerably.

The Texrope Drive provides a flexible coupling between the motor and the driven machine. It absorbs all the shocks that would otherwise be transmitted to the motor. In addition to this Texropes require no lubrication and may be operated on extremely short centers. The Texrope Drive is positive, flexible and has a proven efficiency of 98.9%.

Allis-Chalmers roller bearing motors require only infrequent attention—greasing only a few times yearly. The windings are acid and moisture resisting. Timken bearings permit perfect enclosure and keep out all dirt and dust. These with the steel frames and silver brazed, indestructible rotors contribute to economy and endurance.

ALLIS-CHALMERS MANUFACTURING COMPANY, MILWAUKEE

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Sturtevant Co., B. F., Hyde Park
Westinghouse Elect. & Mfg. Co., Philadelphia

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Braun & Co., C. F., Alhambra
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Braun & Co., C. F., Alhambra
Vogt Mach. Co., Henry, Louisville

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Badger & Sons Co., E. B., Boston
Power Plant Equipment Co., Kansas City, Mo.
Spray Engineering Co., Boston
Yarnall-Waring Co., Phila.

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Braun & Co., C. F., Alhambra
Foster Wheeler Corp., N. Y.
Seymour, Jas. M., Newark
Wheeler Mfg. Co., C. H., Phila.

Couplings, Flexible Shaft, Rigid, Shaft
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De Laval Steam Turbine Co., Trenton, N. J.
Jeffrey Mfg. Co., Columbus
Nicholson & Co., W. H., Wilkes-Barre
Philadelphia (Pa.) Gear Works
Terry Steam Turbine Co., Hartford

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Banner Rock Products Co., Alexandria, Ind.
General Insulating Mfg. Co., Alexandria, Ind.
Johns-Manville Corp., N. Y.
Obermayer Co., S., Chicago

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Consolidated Ashcroft Hancock Co., Inc., N. Y.
Industrial-Brownhoist Corp., Cleveland

Cranes, Creeper, Type, Locomotive, Gas and Steam
American Hoist & Derrick Co., St. Paul
Industrial-Brownhoist Corp., Cleveland
Link-Belt Co., Chicago

Cutters, Boiler Tubes
(See Pipe Cutters)

Dampers
Clarage Fan Co., Kalamazoo, Mich

Deaerators
Cochrane Corp., Phila.
Elliott Co., Jeannette, Pa.
Griscom-Russell Co., N. Y.

Dealers Machinery
(See Searchlight Section)
Dietz Electric Co.
Hunt's Sons, M. J.
Kehoe, Robert P.
Land, L. J.
Moore & MacDonald
National Power Machinery Co.
O'Brien Mchy. Co.
Phoenix Utility Co.
Power Plant Equipment Co.
Ross Power Equipment Co.
Sachsenmaier, Geo.
Stewart & Co., Paul
Zelnicker in St. Louis

Desuperheaters
Elliott Co., Jeanette, Pa.
Superheater Co., N. Y.

Die Stocks
Toledo (Ohio) Pipe Threading Mach.

Diesel Engine, Starting Equipment
Rix Co., San Francisco

Distilling Apparatus (Water)
Bethlehem (Pa.) Steel Co.
Griscom-Russell Co., N. Y.

Draft, Mechanical
(See Blowers, Fan)

Drainers, Low Pressure
Cochrane Corp., Phila.

Dressing, Belt
Dixon Crucible Co., Jos., Jersey City

Drills
Jeffrey Mfg. Co., Columbus

Drop Forgings
Ingersoll-Rand Co., N. Y.
Vogt Mach. Co., Henry, Louisville

Duct Insulation
Banner Rock Products Co., Alexandria, Ind.
General Insulating Mfg. Co., Alexandria, Ind.

Dust Collectors
Sturtevant Co., B. F., Hyde Park

Dynamometers
Leeds & Northrup Co., Phila.
Wheeler Mfg. Co., C. H., Phila.

Dynamos (See Generators)

Economizers
Alberger Heater Co., Buffalo
Foster Wheeler Corp., N. Y.
Green Fuel Economizer Co., Beacon, N. Y.
Sturtevant Co., B. F., Hyde Park

Ejectors
Bethlehem (Pa.) Steel Co.
Chaplin-Fulton Mfg. Co., Pittsburgh
Consolidated Ashcroft Hancock Co., Inc., N. Y.
Elliott Co., Jeanette, Pa.
Nash Engineering So., So. Norwalk
Westinghouse Elect. & Mfg. Co., Philadelphia

Electors, Air
Elliott Co., Jeannette, Pa.
Wheeler Mfg. Co., C. H., Phila.

Electric Generating Sets, Steam Turbine
Allis-Chalmers Mfg. Co., Milwaukee
Elliott Co., Jeannette, Pa.
Moore Steam Turbine Corp., Wellsville, N. Y.
Sturtevant Co., B. F., Hyde Park
Terry Steam Turbine Co., Hartford

Elevators and Conveyors
Beaumont Co., R. H., Phila.
Industrial-Brownhoist Corp., Cleveland
Jeffrey Mfg. Co., Columbus
Link-Belt Co., Chicago

Engine Generators
Elliott Co., Jeanette, Pa.

Engineering Service
Stone & Webster, Inc., Boston

Engines, Corliss
Allis-Chalmers Mfg. Co., Milwaukee
Elliott Co., Jeanette, Pa.

Engines, Diesel
Bethlehem (Pa.) Steel Co.
Fulton Iron Works Co., St. Louis
Lombard Governor Co., Ashland, Mass.
Otto Engine Wks., Philadelphia
Worthington Pump & Mchy. Corp., N. Y.

Engines, Gas and Oil
Allis-Chalmers Mfg. Co., Milwaukee
Fulton Iron Works Co., St. Louis
Ingersoll-Rand Co., N. Y.
Otto Engine Wks., Philadelphia
Worthington Pump & Mchy. Corp., N. Y.
Sterling Engine Co., Buffalo

Engines, Poppet-Valve
Elliott Co., Jeanette, Pa.

Engines, Steam
Air Preheater Corp., N. Y.
Allis-Chalmers Mfg. Co., Milwaukee
Clarage Fan Co., Kalamazoo, Mich.
Fulton Iron Works Co., St. Louis
Elliott Co., Jeanette, Pa.
Murray Iron Wks. Co., Burlington
Skinner Engine Co., Erie
Stanwood Corp., Cincinnati
Sturtevant Co., B. F., Hyde Park
Troy (Pa.) Engine & Machine Co.

Engines, Steam Una-Flow
Elliott Co., Jeanette, Pa.
Skinner Engine Co., Erie

Evaporators
Bartlett-Hayward Co., Baltimore
Bethlehem (Pa.) Steel Co.
Foster Wheeler Corp., N. Y.
Griscom-Russell Co., N. Y.

Exhaust Heads
Burt Mfg. Co., Akron
Hoppes Mfg. Co., Springfield, Ohio
Sturtevant Co., B. F., Hyde Park
Swartwout Co., Cleveland
Wright-Austin Co., N. Y.

Exhausters, Gas
Sturtevant Co., B. F., Hyde Park

Expansion Joints
Badger & Sons Co., E. B., Boston
Elliott Co., Jeanette, Pa.
Foster Wheeler Corp., N. Y.
Grinnell Co., Providence
Griscom-Russell Co., N. Y.
Howard Iron Works, Buffalo
Wheeler Mfg. Co., C. H., Phila.

Fans, Exhaust and Ventilator
(See Blowers, Fan)

Fans, Forced Draft
Coppus Engineering Corp., Worcester
Green Fuel Economizer Co., Beacon
Sturtevant Co., B. F., Hyde Park

Filters, Feed Water, Pressure—Water
Braun & Co., C. F., Alhambra
Cochrane Corp., Phila.
Elliott Co., Jeannette, Pa.
Griscom-Russell Co., N. Y.
Permutit Co., N. Y.

Filters, Oil
Burt Mfg. Co., Akron
Bowser & Co., S. F., Ft. Wayne
Elliott Co., Jeannette, Pa.
Nugent & Co., Wm. W., Chicago

Filters, Oil Removal
Braun & Co., C. F., Alhambra
Elliott Co., Jeanette, Pa.
Griscom-Russell Co., N. Y.
Permutit Co., N. Y.

Filters, Oil System
Burt Mfg. Co., Akron

Fire Extinguishers
Badger & Sons Co., E. B., Boston

Fire Hydrants
Howard Iron Works, Buffalo

Firebox Blocks
Bernitz Furnace Appliance Co., Boston
Carborundum Co., Perth Amboy
McLeod & Henry Co., Troy, N. Y.
Norton Co., Worcester

Fittings, Ammonia
Greene, Tweed & Co., N. Y.
Vogt Machine & Co., Henry, Louis-

Fittings, Steel
Pittsburgh (Pa.) Piping & Equip. Co.

Flanges
Dart Mfg. Co., E. M., Providence
Grinnell Co., Providence
Jefferson Union Co., Lexington,
Jenkins Bros., N. Y.
Limbert & Co., Geo. B., Chicago
Pittsburgh (Pa.) Piping & Equip. Co.
Power Piping Co., Pittsburgh
Vogt Machine Co., Henry, Louisville

Floats
Hercules Float Wks., Springfield, Mass.

Flooring, Armoring
Hendrick Mfg. Co., Carbondale

Flooring, Fireproof
Tri-Lok Co., Pittsburgh

Flooring, Monolithic
Johns-Manville Corp., N. Y.

Flooring, Non-Slipping
Tri-Lok Co., Pittsburgh

Flooring, Open Steel
Hendrick Mfg. Co., Carbondale
Tri-Lok Co., Pittsburgh

Flooring, Steel
Tri-Lok Co., Pittsburgh

Flooring, Ventilating
Tri-Lok Co., Pittsburgh

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Huyette Co., Paul B., Phila.

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International Nickel Co., N. Y.

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Engineer Co., N. Y.
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Peabody Engineering Corp., N. Y.
Todd Dry Dock Eng. & Repair Corp., Brooklyn

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Biglow-Liptak Corp., Detroit
Carborundum Co., Perth Amboy
Detrick Co., M. H., Chicago
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Norton Co., Worcester
Obermayer Co. S., Chicago
Queens Run Refractories Co., Lock Haven

Furnace Bottoms, Cast Iron Air Cooled
Allen, Sherman, Hoff Co., Phila

Furnace Construction
Cement Gun Co., Allentown
Plibrico Jointless Fire Brick Co., Chicago

Furnace Linings
American Engineering Co., Phila.
Babcock & Wilcox Co., N. Y.
Bernitz Furnace Appliance Co., Boston
Carborundum Co., Perth Amboy
Cement Gun Co., Allentown
General Refractories Co., Phila.
Harbison-Walker Refractories Co., Pittsburgh
Keystone Refractories Co., N. Y.
Laclede-Christy, St. Louis
McLeod & Henry Co, Troy, N. Y.
Norton Co., Worcester
Obermayer Co. S., Chicago
Plibrico Jointless Fire Brick Co.,
Queens Run Refractories Co., Lock Haven

Furnace Walls, Water Cooled
American Engineering Co., Phila.
Combustion Eng. Corp., N. Y.
Foster Wheeler Corp., N. Y.
International Combustion Eng. Corp., N. Y.
Superheater Co., N. Y.

Furnaces
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Combustion Engineering Corp., N. Y.
Detroit (Mich.) Stoker Co.
Fuller Lehigh Co., Fullerton, Pa.
International Combustion Engineering Corp., N. Y.
Jeffrey Mfg. Co., Columbus
McClave-Brooks Co., Scranton, Pa.

Furnaces, Bagasse & Wood Burning
Combustion Engineering Corp., N. Y.
Detrick Co., M. H., Chicago
International Combustion Engineering Corp., N. Y.
McClave-Brooks Co., Scranton, Pa.

Furnaces, Incinerator
Combustion Engineering Corp., N. Y.
International Combustion Engineering Corp., N. Y.
McClave-Brooks Co., Scranton, Pa

Gage Glass Guards & Shields
Jenkins Bros, N. Y.
Wright-Austin Co., N. Y.

Gage Glasses
Chesterton Co., A. W., Boston
Durabla Mfg. Co., N. Y.
Jenkins Bros, N. Y.

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Bristol Co., Waterbury
Consolidated Ashcroft Hancock Co., Inc., N. Y.
Crosby Steam Gage & Valve Co., Boston
Foxboro Co., Foxboro
Greene, Tweed & Co., N. Y.
Jenkins Bros., N. Y.
Republic Flow Meters Co., Chicago
Yarnall-Waring Co., Philadelphia

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Mettler Co., Lee B., Los Angeles
Peabody Engineering Corp., N. Y.

Gas Exhausters
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Gas Welding
Prest-O-Lite Co., N. Y.

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Advance Packing & Supply Co., Chicago
Belmont Packing & Rubber Co., Philadelphia
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Crandall Packing Co. Palmyra
Flexitallic Gasket Co., Camden, N. J.
Garlock Packing Co., Palmyra, N. Y
Greene, Tweed & Co., N. Y.
Jenkins Bros., N. Y.
Metallo Gasket Co., New Brunswick
Quaker City Rubber Co., Wissinoming
Smooth-On Mfg. Co., Jersey City, N.J.

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McClave-Brooks Co., Scranton.

Gates, Coal & Ash Bin
Allen, Sherman, Hoff Co., Phila.
Beaumont Co., R. H., Phila.

Hunt Co., C. W., West New Brighton N. Y.
Industrial-Brownhoist Corp., Cleveland
Jeffrey Mfg. Co., Columbus
Link-Belt Co., Chicago

Gauges
American Schaeffer & Budenberg Corp., Brooklyn

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Cleveland (O.) Worm & Gear Co.
General Electric Co., Schenectady
Jeffrey Mfg. Co., Columbus
Link-Belt Co., Chicago
Nuttall Co., R. D., Pittsburgh
Philadelphia (Pa.) Gear Works
Westinghouse Elect. & Mfg. Co., Philadelphia

Gears, Double Helical
De Laval Steam Turbine Co., Trenton, N. J.

Gears, Reduction
Cleveland (O.) Worm & Gear Co.
De Laval Steam Turbine Co., Trenton, N. J.
Elliott Co., Jeannette, Pa.
Moore Steam Turbine Corp., Wellsville, N. Y.
Nuttall Co., R. D., Pittsburgh
Philadelphia (Pa.) Gear Works
Sturtevant Co., B. F., Hyde Park
Terry Steam Turbine Co., Hartford
Westinghouse Elect. & Mfg. Co., Philadelphia

Generating Sets
Elliott Co., Jeanette, Pa.
General Electric Co., Schenectady
Sturtevant Co., B. F., Hyde Park

Generators
Lincoln Elect. Co., Cleveland

Generators, Electric
Elliott Co., Jeanette
Sturtevant Co., B. F., Hyde Park
Westinghouse Elect. & Mfg. Co., Philadelphia

Governors, Engine
Gardner-Denver Co., Quincy

Governors, Pressure
Northern Equipment Co., Erie

Governors, Pump
Atlas Valve Co., Newark
Chaplin-Fulton Mfg. Co., Pittsburgh
Davis Regulator Co., G. M., Chicago
Northern Equipment Co., Erie
Strong, Carlisle & Hammond Co., Cleveland
Swartwout Co., Cleveland
Todd Dry Dock Eng. & Repair Corp., Brooklyn

Governors, Water-Wheel
Lombard Governor Co., Ashland.

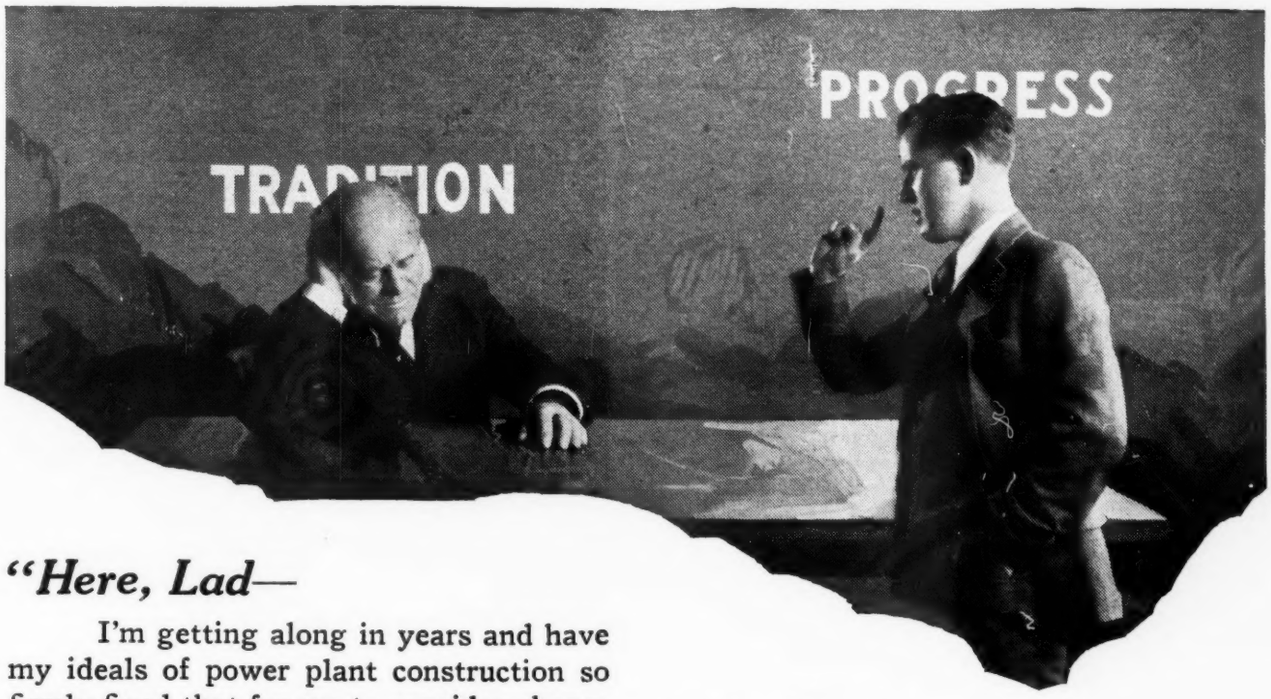
Graphite
Dixon Crucible Co., Jos., Jersey City
Greene, Tweed & Co., N. Y.
United States Graphite Co., Saginaw

Grates, Dumping
Auburn (Ind.) Stoker Corp.
Babcock & Wilcox Co., N. Y.
CoKal Stoker Corp., Chicago
Combustion Eng. Corp., N. Y.
Cyclone Grate Bar Co., Buffalo
International Combustion Engineering Corp., N. Y.
Kelly Foundry & Machine Co., Goshen
McClave-Brooks Co., Scranton, Pa
Marion (Ind.) Mach., Fdry. & Supply Co.
Neemes Fdry., Inc., Troy
Riley Stoker Corp., Worcester
Vogt Mach. Co., Henry, Louisville

Grates, Shaking
Auburn (Ind.) Stoker Corp.
Babcock & Wilcox Co., N. Y.
CoKal Stoker Corp., Chicago
Combustion Eng. Corp., N. Y.
Cyclone Grate Bar Co., Buffalo
International Combustion Engineering, Corp., N. Y.
Kelly Foundry & Machine Co., Goshen
McClave-Brooks Co., Scranton, Pa.
Marion (Ind.) Mach., Fdry. & Supply Co.
Neemes Fdry., Inc., Troy
Vogt Mach. Co., Henry, Louisville

Grates, Stationary
Auburn (Ind.) Stoker Corp.
Babcock & Wilcox Co., N. Y.

Has Pop the power to change his mind?



"Here, Lad—

I'm getting along in years and have my ideals of power plant construction so firmly fixed that for me to consider changing to arc welding for the new power plant —well, I'm just too old to learn."

"No, Pop—

age is not a time of life—it's a state of mind and a state of mind can be changed. But you don't need to change your ideal.

Your one ideal is to reduce power generating cost. Didn't you read the first editorial on page 892, December 6, 1927 issue of POWER 'Welding and Kilowatt-Hours' where it says:

> "One of the most interesting of these changes is the promise of lower power-generation costs that should follow the full and proper use of this method of fabrication (arc welding) in the modern power plant."

Since arc welding helps you toward that ideal, start thinking THAT over young Pop.

A man is never too old to learn—but he's usually too young to realize it."

Only "Stable-Arc" Welders have all these features

Variable Voltage.
Laminated Magnetic Circuit.
Separately-excited Generator Field.
Double Control of Welding Heat.
Steady Arc Throughout Entire Welding Range.
All Steel Construction.
Full Capacity for either Metallic or Carbon Arc Welding.

These features make welding easier. Results—better welds and greater output.
Ask any Operator!

The Lincoln Electric Co., Dept. No. 2-6, Cleveland, Ohio

W-46

LINCOLN "Stable Arc" WELDER

CoKal Stoker Corp., Chicago
Combustion Eng. Corp., N. Y.
Cyclone Grate Bar Co., Buffalo
International Combustion Engineering Corp., N. Y.
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McClave-Brooks Co., Scranton, Pa.
Marion (Ind.) Mach., Fdry. & Supply Co.
Neemes Fdry., Inc., Troy
Riley Stoker Corp., Worcester
Vogt Mach. Co., Henry, Louisville

Gratings
Hendrick Mfg. Co., Carbondale
Tri-Lok Co., Pittsburgh

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Dixon Crucible Co., Jos., Jersey City

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Foster-Wheeler Corp., N. Y.
Superheater Co., N. Y.
Westinghouse Elect. & Mfg. Co., Philadelphia
Wheeler Mfg. Co., C. H., Phila.

Heaters, Air
Air Preheater Co., N. Y.
Babcock & Wilcox Co., N. Y.
Combustion Engineering Corp., N. Y.
Foster Wheeler Corp., N. Y.
International Combustion Engr. Corp., N. Y.
Prat-Daniel Corp., N. Y.
Sturtevant Co., B. F., Hyde Park

Heaters, Bleeder
Foster-Wheeler Corp., N. Y.

Heaters, Deaerating
Cochrane Corp., Phila.
Elliott Co., Jeannette, Pa.

Heaters, Domestic
Alberger Heater Co., Buffalo

Heaters, Feed Water
Alberger Heater Co., Buffalo
Bethlehem (Pa.) Steel Co.
Braun & Co., C. F., Alhambra
Cochrane Corp., Phila.
Elliott Co., Jeannette, Pa.
Foster Wheeler Corp., N. Y.
Griscom-Russell Co., N. Y.
Neemes Fdry., Troy, N. Y.
Patterson-Kelley Co., N. Y.
Schutte-Koerting Co., Phila.
Sturtevant Co., B. F., Hyde Park
Swartwout Co., Cleveland
Westinghouse Elect. & Mfg. Co., Philadelphia
Wheeler Mfg. Co., C. H., Phila.

Heaters, Hot Water Service
Foster-Wheeler Corp., N. Y.
Patterson Kelley Co., N. Y.
Templeton Steam Trap Co., N. Y.

Heaters, Metering
Cochrane Corp., Phila.

Heaters, Oil
Alberger Heater Co., Buffalo
Braun & Co., C. F., Alhambra
Coen Co., San Francisco
Foster-Wheeler Corp., N. Y.
Griscom Russell Co., N. Y.
Hammel Oil Burning Equipt. Co. Providence
Patterson-Kelley Co., N. Y.
Todd Dry Dock Eng. & Repair Corp., Brooklyn

Heaters, Steam Stack
Cochrane Corp., Phila.

Heaters, Storage
Cochrane Corp., Phila.
Patterson-Kelley Co., N. Y.

Heaters, Unit
Sturtevant Co., B. F., Hyde Park

Heating and Ventilating Systems
Clarage Fan Co., Kalamazoo, Mich.
Prat-Daniel Corp., N. Y.
Sturtevant Co., B. F., Hyde Park

Hoists, Air
Ingersoll-Rand Co. N. Y.
Lagonda Mfg. Co., Springfield, Ohio

Hoists, Electric
Beaumont Co., R. H., Phila.

Hoists, Portable
Sullivan Machinery Co., Chicago

Hoists, Steam
Sullivan Machinery Co., Chicago

Hoppers, Coal and Ash
Allen, Sherman, Hoff Co., Phila.
Beaumont Co., R. H., Phila.
Combustion Eng. Corp., N. Y.
International Combustion Engr. Corp., N. Y.
Jeffrey Mfg. Co., Columbus
Link-Belt Co. Chicago

Hose, Rubber, For Air, Steam, Tube Cleaners, Water
Lagonda Mfg. Co., Springfield, Ohio
Quaker City Rubber Co., Wissinoming

Ice and Refrigerating Machinery
(See Refrigerating Machinery)

Idlers, Conveyors
Robins Conveying Belt Co., N. Y.

Indicators, Combustion
Permutit Co., N. Y.

Indicators, Speed
Biddle, James G., Phila.
Geo. Scherr Co., N. Y.
Zernickow Co., O., N. Y.

Indicator, Steam Engine
Crosby Steam Gage & Valve Co., Boston

Indicators, Valve Position
Northern Equipment Co., Erie

Injectors
Consolidated Ashcroft Hancock Co., Inc., N. Y.
Jenkins Bros. N. Y.

Instruments, Recording
Permutit Co., N. Y.

Insulating Materials
Banner Rock Products Co., Alexandria, Ind.

Insulation Boiler
General Insulating Mfg. Co., Alexandria, Ind.
Johns-Manville Corp., N. Y.

Insulation, Duct
General Insulating Mfg. Co., Alexandria, Ind.

Insulation, Heat
Banner Rock Products Co., Alexandria, Ind.

Intercoolers
Braun & Co., C. F., Alhambra
Foster-Wheeler Corp., N. Y.

Griscom-Russell Co., N. Y.

Lubricators, Cylinder
Greene, Tweed & Co., N. Y.
Lunkenheimer Co., Cincinnati

Lubricators, Force Feed
Bowser & Co., S. F., Ft. Wayne
Greene, Tweed & Co., N. Y.

Machine, Special Work
Howard Iron Works, Buffalo

Machine Screws, Monel Metal
International Nickel Co., N. Y.

Metal, Bearing
Magnolia Metal Co., N. Y.

Metal, Sheets, Rods, Castings
International Nickel Co., N. Y.

Metals, Perforated
Hendrick Mfg. Co., Carbondale

Meters, Air, Boiler, Flow, Gas, Oil, Water, Steam
Bailey Meter Co., Cleveland
Bowser & Co., S. F., Ft. Wayne
Cochrane Corp., Phila.
Elliott Co., Jeanette, Pa.
General Electric Co., Schenectady
Republic Flow Meters Co. Chicago
Worthington Pump & Mchy. Corp., N. Y.
Yarnall-Waring Co., Phila.

Meters, Coal
Bailey Meter Co., Cleveland
Republic Flow Meters Co., Chicago

Meters, Electric
General Electric Co., Schenectady
Westinghouse Elect. & Mfg. Co., Philadelphia

Meters V-Notch
Bailey Meter Co., Cleveland
Cochrane Corp., Phila.
Yarnall-Waring Co., Mermaid Ave., Phila.

Meters, Volumetric
Cochrane Corp., Phila.
Yarnall-Waring Co., Philadelphia

Meters, Weighing
Cochrane Corp., Phila.

Motor Generators
Elliott Co., Jeanette, Pa.

Motors, Electric
Allis-Chalmers Mfg. Co., Milwaukee
Elliott Co., Jeanette, Pa.
Fairbanks, Morse & Co., Chicago
Lincoln Elect. Co., Cleveland
Sturtevant Co., B. F., Hyde Park
Westinghouse Elect. & Mfg. Co., Philadelphia

Motors, Synchronous
Elliott Co., Jeanette, Pa.

Motors, Water
Roto Co., Newark

Nickel, Sheets, Rod & Castings
American Mond Nickel Co., Pittsburgh
International Nickel Co., N. Y.

Nipples, Pipe
Pipe-Saver Corp. of America, Carthage, N. Y.

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Texas Co., N. Y.

Oil, Lubricating
Dearborn Chemical Co., Chicago

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Bowser & Co., S. F., Ft. Wayne
De Laval Separator Co., N. Y.

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Bowser & Co., S. F., Ft. Wayne
Burt Mfg. Co., Akron

Oil Storage Equipment
Bowser & Co., S. F., Fort Wayne, Ind.

Oilers Sight Feed and Multiple
Bowser & Co., S. F., Ft. Wayne
Nugent & Co., Wm. W., Chicago

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Burt Mfg. Co., Akron
Nugent & Co., Wm. W., Chicago

Oxygen, Gas
Keasbey & Mattison Co., Ambler

Packing, Asbestos
Advance Packing & Supply Co., Chicago
Belmont Packing & Rubber Co., Philadelphia
Colts Patent Fire Arms Mfg. Co., Hartford
Crandall Packing Co. Palmyra
Durabla Mfg. Co., N. Y.
Garlock Packing Co., Palmyra, N. Y.
Greene, Tweed & Co., N. Y.
Johns-Manville Corp., N. Y.

Packing, Condenser, Tube
Garlock Packing Co., Palmyra

Packing, Cylinder, Hydraulic, Piston, Rod, Sheet, Valve Stem, Pump Valve
Advance Packing & Supply Co., Chicago
Belmont Packing & Rubber Co., Philadelphia
Chesterton Co., A. W., Boston
Colts Patent Fire Arms Mfg. Co., Hartford
Conneaut Packing Co., Conneaut, O.
Crandall Packing Co. Palmyra
Durabla Mfg. Co., N. Y.
Garlock Packing Co., Palmyra, N. Y.
Greene, Tweed & Co., N. Y.
Jenkins Bros., N. Y.
Johns-Manville Corp., N. Y.
Quaker City Rubber Co., Wissinoming

Packing, Flax
Chesterton Co., A. W., Boston
Crandall Packing Co. Palmyra
Garlock Packing Co., Palmyra, N. Y.
Greene, Tweed & Co., N. Y.

Packing, Metallic
Conneaut Packing Co., Conneaut, O.
Crandall Packing Co. Palmyra
Durabla Mfg. Co., N. Y.
France Packing Co., Philadelphia
Garlock Packing Co., Palmyra, N. Y.

Packing, Metallic Flexible
Crandall Packing Co. Palmyra
France Packing Co., Philadelphia
Garlock Packing Co., Palmyra, N. Y.

Packing, Plastic, Metallic
Conneaut Packing Co., Conneaut, O.

Paint Graphite
Dixon Crucible Co., Jos., Jersey City

Paints, Anti-Corrosive
Quigley Furnace Specialties Co., N.Y.

Paints, Industrial
Quigley Furnace Specialties Co., N.Y.

Paints, Rust Proofing
Dearborn Chemical Co., Chicago

Pipe
Grinnell Co., Providence
Kellogg Co., M. W., N. Y.
Power Piping Co., Pittsburgh
Reading Iron Co., Reading

Pipe Bending
American Pipe Bending Mach. Co., Boston
Grinnell Co., Providence
Kellogg Co., M. W., N. Y.
Power Piping Co., Pittsburgh

Pipe, Brass & Copper
Foster-Wheeler Corp., N. Y.
Scoville Mfg. Co., Waterbury
Simmons Co., John, N. Y.

Pipe Coils
Abendroth & Root Mfg. Co., N. Y.
Superheater Co., N. Y.

Pipe Cutting and Threading Machines
Toledo (Ohio) Pipe Threading Mach. Co.

Pipe Fittings
Grinnell Co., Providence
Jefferson Union Co., Lexington.
Kellogg Co., M. W., N. Y.
Pittsburgh (Pa.) Piping & Equip. Co.
Power Piping Co., Pittsburgh
Walworth Co., Boston

Pipe Spiral, Riveted
Abendroth & Root Mfg. Co., N. Y.

Pipe, Welded & Seamless
Kellogg Co., M. W., N. Y.

Piping Contractors
Baker Co., R. H., Cambridge
Grinnell Co., Providence
Kellogg Co., M. W., N. Y.
Pittsburgh (Pa.) Piping & Equip. Co.
Pittsburgh (Pa.) Valve & Fdry. & Const. Co.
Power Piping Co., Pittsburgh

Piping, Fabricators
Kellogg Co., M. W., N. Y.
Reading Iron Co., Reading

Piping, High Pressure
Baker Co., R. H., Cambridge
Kellogg Co., M. W., N. Y.
Pittsburgh (Pa.) Valve & Fdry. & Const. Co.
Pittsburgh (Pa.) Piping & Equip. Co.
Power Piping Co., Pittsburgh
Reading Iron Co., Reading

Piston Rings
Bartlett-Hayward Co., Baltimore

Pneumatic Tools
Ingersoll-Rand Co., N. Y.

Power Plant Construction
Stone & Webster, Inc., Boston

Power Station Construction
Stone & Webster, Inc., Boston

Power Transmission Machinery
Allis-Chalmers Mfg. Co., Milwaukee
Jeffrey Mfg. Co., Columbus
Link-Belt Co., Chicago

Pre-Heaters, Air
Air-Preheater Corp., N. Y.
Buffalo Forge Co., Buffalo
Combustion Engineering Corp., N. Y.
Foster Wheeler Corp., N. Y.
Green Fuel Economizer Co., Beacon
International Combustion Engineering Corp., N. Y.
Prat-Daniel Corp., N. Y.
Sturtevant Co., B. F., Hyde Park

Psychrometers, Recording
Foxboro Co., Foxboro

Pulleys
Greene, Tweed & Co., N. Y.

Pulverized Coal Equipment
Bethlehem (Pa.) Steel Co.
Combustion Engineering Corp., N. Y.
Foster Wheeler Corp., N. Y.
Fuller Lehigh, Fullerton
International Combustion Engr. Corp., N. Y.
Jeffrey Mfg. Co., Columbus
Peabody Engineering Corp., N. Y.
Riley Stoker Corp., Worcester
Streng-Scott Mfg. Co., Minneapolis

Pump Liners, Monel Metal
International Nickel Co., N. Y.

Pump Liners, Nickel
American Mond Nickel Co., Pittsburgh

Pump Rods, Monel Metal
International Nickel Co., N. Y.

Pump Rods, Nickel
American Mond Nickel Co., Pittsburgh

Pumps, Air
Elliott Co., Jeannette, Pa.
Foster Wheeler Corp., N. Y.
Wheeler Mfg. Co., C. H., Phila.

Pumps, Air Lift
Ingersoll-Rand Co. N. Y.
Pennsylvania Pump & Compressor Co., Easton, Pa.

Pumps, Boiler Feed
Cameron Steam Pump Works A. S., N. Y. (Ingersoll-Rand Co.)
Ingersoll-Rand Co., N. Y. (A. S. Cameron Steam Pump Works)

Pumps, Centrifugal
Allis-Chalmers Mfg. Co., Milwaukee
Bethlehem (Pa.) Steel Co.
Buffalo Steam Pump Co., Buffalo
Cameron Steam Pump Works, A. S., N. Y. (Ingersoll-Rand Co.)
De Laval Steam Turbine Co., Trenton, N. J.
Elliott Co., Jeannette, Pa.
Foster-Wheeler Corp., N. Y.
Frederick (Md.) Iron & Steel Co.
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Wks.), N. Y.
Lecourtenay Co., Newark, N. J.
Manistee (Mich.) Iron Works Co
Moore Steam Turbine Corp., Wellsville, N. Y.
Nash Engineering So., So. Norwalk
Pennsylvania Pump & Compressor Co., Easton, Pa.
Terry Steam Turbine Co., Hartford
Westco-Chippewa Pump Co., Davenport, Ia.
Wheeler Mfg. Co., C. H., Phila.
Worthington Pump & Mchy. Corp., N. Y.

Pumps, Condensate
Cameron Steam Pump Works, A. S., N. Y. (Ingersoll-Rand Co.)
Elliott Co., Jeannette, Pa.
Ingersoll-Rand Co. (Cameron Steam Pump Wks., A. S.), N. Y.

Pumps, Deep Well
Westco-Chippewa Pump Co., Davenport, Iowa
Worthington Pump & Mchy. Corp., N. Y.

Pumps, Oil
Coen Co., San Francisco
Hammel Oil Burning Equipt. Co. Providence
Lunkenheimer Co., Cincinnati
Schutte & Koerting Co., Phila.

Pumps, Power
Gardner-Denver Co., Quincy
Platt Iron Works, Dayton, Ohio
Westco-Chippewa Pump Co., Davenport, Ia.
Worthington Pump & Mchy. Corp., N. Y.

Pumps, Reciprocating
Allis-Chalmers Mfg. Co., Milwaukee
Buffalo (N. Y.) Steam Pump Co.
Cameron Steam Pump Works, A. S., N. Y. (Ingersoll-Rand Co.)
Gardner-Denver Co., Quincy
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Wks.), N. Y.
Manistee (Mich.) Iron Works Co.
Platt Iron Works, Dayton
Westco-Chippewa Pump Co., Davenport, Ia.
Worthington Pump & Mchy. Corp., N. Y.

Pumps, Rotary
Bowser & Co., S. F., Ft. Wayne
Wheeler Mfg. Co., C. H., Phila.

Pumps, Steam
Cameron Steam Pump Works, A. S., N. Y. (Ingersoll-Rand Co.)
Ingersoll-Rand Co., N. Y. (A. S., Cameron Steam)

Pumps, Sump
Cameron Steam Pump Works, A. S., N. Y. (Ingersoll-Rand Co.)
Elliott Co., Jeannette, Pa.
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Wks.), N. Y.
Sullivan Machinery Co., Chicago
Wheeler Mfg. Co., C. H., Phila.
Worthington Pump & Mchy. Corp., N. Y.

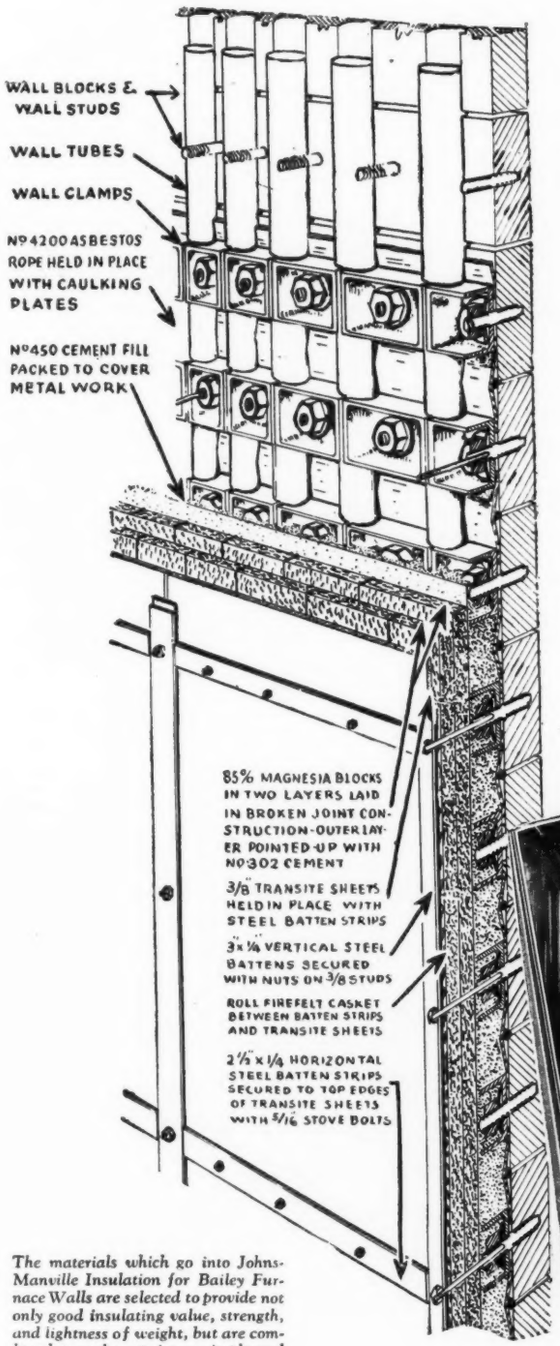
Pumps, Vacuum
Foster-Wheeler Corp., N. Y.
Ingersoll-Rand Co. N. Y.
Worthington Pump & Mchy. Corp., N. Y.

Purifiers, Feed Water
Cochrane Corp., Phila., Pa.
Griscom-Russell Co., N. Y.
Hagan Corp., Pittsburgh
Permutit Co., N. Y.
Yarnall-Waring Co., Phila., Pa.

Johns-Manville TRANSITE CASED Insulation

for BAILEY FURNACE WALLS

Insures . .


WALL BLOCKS & WALL STUDS
WALL TUBES
WALL CLAMPS
No 4200 ASBESTOS ROPE HELD IN PLACE WITH CAULKING PLATES
No 450 CEMENT FILL PACKED TO COVER METAL WORK
85% MAGNESIA BLOCKS IN TWO LAYERS LAID IN BROKEN JOINT CONSTRUCTION-OUTER LAYER POINTED UP WITH No 302 CEMENT
3/8" TRANSITE SHEETS HELD IN PLACE WITH STEEL BATTEN STRIPS
3" x 1/4" VERTICAL STEEL BATTENS SECURED WITH NUTS ON 3/8" STUDS
ROLL FIREFELT GASKET BETWEEN BATTEN STRIPS AND TRANSITE SHEETS
2 1/2" x 1/4" HORIZONTAL STEEL BATTEN STRIPS SECURED TO TOP EDGES OF TRANSITE SHEETS WITH 5/16" STOVE BOLTS

The materials which go into Johns-Manville Insulation for Bailey Furnace Walls are selected to provide not only good insulating value, strength, and lightness of weight, but are combined to make repairs as simple and convenient as possible.

1—High furnace efficiency; 2—reduced heat loss due to conduction and radiation; 3—permanence of construction; 4—exceptional convenience in making repairs.

The illustration clearly shows the construction of this insulation. It is entirely supported on the furnace wall, and is tightly held against it at all times. Leakage and draft or flue effect between the insulation and the casing, which frequently occurs with independently supported casings, cannot lower furnace efficiency when the Johns-Manville insulation construction is used.

The Transite casing itself is an excellent insulator when compared with steel, so that the heat loss due to conduction and radiation is small. Transite is non-corrosive and will not rot, rust, warp, split, crack or decay.

The insulation construction is designed to be readily removable and replaceable. It is possible to remove one panel, or a vertical or horizontal row of panels, without disturbing the adjacent insulation.

There is a J-M Method of Insulation for every type of furnace wall. Submit your insulating problems to our Engineering Staff.

J-M Insulation applied to Bailey Furnace Walls built by Fuller Lehigh Co., Fullerton, Pa., for two B. & W. Oil Fired Boilers at the Savannah Electric & Power Co., Savannah, Ga.

MASTER of ASBESTOS

Johns-Manville

FURNACE WALL INSULATION

JOHNS-MANVILLE CORPORATION
New York, Chicago, Cleveland, San Francisco
Branches in all large cities
Canadian Johns-Manville Co., Ltd., Toronto
(Mail this coupon to branch nearest you)
Please send me information about the use of Johns-Manville Insulation for Bailey Furnace Walls.

*Name*_____

FWI-49-6

*Address*_____

Purifiers, Steam
Andrews-Bradshaw Co., (Division of Blaw-Knox Co.) Pittsburgh
Blaw-Knox Co., Pittsburgh

Pyrometers
Bristol Co., Waterbury
Leeds & Northrup Co., Phila.
Republic Flow Meters Co., Chicago
Superheater Co., N. Y.
Taylor Instrument Co.'s, Rochester

Recorders, Draft
Republic Flow Meters Co., Chicago

Recorders, Gas Density
Permutit Co., N. Y.

Recorders, Pressure
American Schaeffer & Budenberg Corp., Bklyn.
Crosby Steam Gage & Valve Co., Boston
Taylor Instrument Co.'s, Rochester

Recorders, Vacuum
Crosby Steam Gage & Valve Co., Boston

Refractory Placing Machines
Cement Gun Co., Allentown
Quigley Furnace Specialties Co., N.Y.

Refractory, Shapes, Special
Babcock & Wilcox Co., N. Y.

Refrigerating Machinery
Ingersoll-Rand Co., N. Y.
Vogt Machine Co., Henry, Louisville

Regulators, Blower
McClave-Brooks Co., Scranton, Pa.

Regulators, Damper, Draft and Fan
Atlas Valve Co., Newark
Hagan Corp., Pittsburgh
Leeds & Northrup Co., Phila.
Powers Regulator Co., Chicago
Smoot Engr. Corp., N. Y.

Regulators, Feed Water
Atlas Valve Co., Newark
Mason Regulator Co., Boston
Northern Equipment Co., Erie
Todd Dry Dock Eng. & Repair Corp., Brooklyn

Regulators, Gas
Davis Regulator Co., G. M., Chicago

Regulators, Pressure
Brown Inst. Co., Phila.
Chaplin-Fulton Mfg. Co., Pittsburgh
Davis Regulator Co., G. M., Chicago
Engineer Co., N. Y.
Mason Regulator Co., Boston
Northern Equipment Co., Erie
Powers Regulator Co., Chicago
Strong, Carlisle & Hammond Co., Cleveland
Taylor Instrument Co.'s, Rochester

Regulators, Pump
Mason Regulator Co., Boston
Northern Equipment Co., Erie

Regulators, Temperature
American Schaeffer & Budenberg Corp., Brooklyn
Bristol Co., Waterbury
Powers Regulator Co., Chicago

Resuperheaters
Superheater Co., N. Y.

Rings, Weldless Monel Metal
International Nickel Co., N. Y.

Rods, Monel Metal
International Nickel Co., N. Y.

Rope Transmission
American Steel & Wire Co., Chicago
Hunt Co., C. W., West New Brighton, N. Y.

Rubber Goods
Quaker City Rubber Co., Wissinoming

Rust Preventatives
Dearborn Chemical Co., Chicago

Safety Devices, Oil Burning
Todd Dry Dock Eng. & Repair Corp., Brooklyn

Safety Steps, Steel
Hendrick Mfg. Co., Carbondale

Scale Removers
General Specialty Co., Buffalo
Lagonda Mfg. Co., Springfield, O.
Roto Co., Newark

Screens, Perforated Metal
Hendrick Mfg. Co., Carbondale

Screens, Shaking & Vibrating
Robins Conveying Belt Co., N. Y.

Screens, Water Intake
Link-Belt Co., Chicago

Second-Hand Equipment (See Searchlight Section)
Dietz Electric Co.
Hunt's Sons, M. J.,
Kehoe, Robert P.
Land, L. J.
Moore & MacDonald
National Power Machinery Co.
O'Brien Mchy. Co.
Phoenix Utility Co.
Ross Power Equipment Co.
Sachsenmaier, Geo.
Stewart & Co., Paul
Zelnicker in St. Louis

Separators, Air, Ammonia, Oil, Steam
Andrews-Bradshaw Co., (Division of Blaw-Knox Co.) Pittsburgh
Cochrane Corp., Phila.
De Laval Separator Co., N. Y.
Elliott Co., Jeannette
Griscom-Russell Co., N. Y.
Hagan Corp., Pittsburgh
Nicholson & Co., W. H., Wilkes-Barre, Pa.
Strong, Carlisle & Hammond Co., Cleveland

Swartwout Co., Cleveland
Templeton Steam Trap Co., N. Y.
Wright-Austin Co., N. Y.

Separators, Receiver
Cochrane Corp., Phila.

Sheets, Monel Metal
International Nickel Co., N. Y.

Skimmers, Boiler
Yarnall-Waring Co., Phila. Pa.

Sound Locater & Amplifier
International Metal Specialty Co., Berlin

Speed Reducers
Bowser & Co., S. F., Ft. Wayne
De Laval Steam Turbine Co., Trenton, N. J.
Nuttall Co., R. D., Pittsburgh
Philadelphia (Pa.) Gear Works

Spray Nozzles
(See Cooling Plants and Ponds)

Stacks, Brick, Radial Brick
Ballard, Sprague & Co., N. Y.
Custodis Chimney Constr. Co., Alphons, N. Y.
Kellogg Co., M. W., N. Y.
Rust Engineering Co., Pittsburgh

Stacks, Concrete
Custodis Chimney Construction Co., Alphons, N. Y.
Rust Engineering Co., Pittsburgh

Stacks, Metal
Coatsville (Pa.) Boiler Works
Connery & Co., Philadelphia
Heine Boiler Co., N. Y.
Prat-Daniel Corp., N. Y.
Union Iron Works, Erie, Pa.
Walsh & Weidner Boiler Co., Chattanooga

Steel Plate Work
Hendrick Mfg. Co., Carbondale
Murray Iron Wks. Co., Burlington
Union Iron Wks., Erie, Pa.

Stokers, Chain and Traveling Grate
Babcock & Wilcox Co., N. Y.
Combustion Engineering Corp., N. Y.
International Combustion Engineering Corp., N. Y.
Laclede Stoker Co., St. Louis, Mo.
McClave-Brooks Co., Scranton, Pa.
Riley Stoker Corp., Worcester

Stokers, Hand Operated
Auburn Stoker Corp., Auburn, Ind.
CoKal Stoker Corp., Chicago
Combustion Engineering Corp., N. Y.
International Combustion Engineering Corp., N. Y.
Flynn & Emrich Co., Baltimore
McClave-Brooks Co., Scranton, Pa.
Marion (Ind.) Mach., Fdry. & Supply Co.

Stokers, Mechanical
American Engineering Co., Phila.
Auburn Stoker Corp., Auburn, Ind.
Babcock & Wilcox Co., N. Y.
CoKal Stoker Corp., Chicago
Combustion Engineering Corp., N. Y.
Detroit (Mich.) Stoker Co.
Flynn & Emrich Co., Baltimore
International Combustion Engineering Corp., N. Y.
McClave-Brooks Co., Scranton
Riley Stoker Corp., Worcester
Sturtevant Co., B. F., Hyde Park
Westinghouse Elect. & Mfg. Co., Philadelphia

Stops, Engine
Gas Combustion Co., Pittsburgh

Strainers, Oil, Water
Braun & Co., C. F., Alhambra
Coen Co., San Francisco
Elliott Co., Jeannette, Pa.
Griscom-Russell Co., N. Y.
Sarco Co., Inc., N. Y.
Strong, Carlisle & Hammond Co., Cleveland
Todd Dry Dock Eng. & Repair Corp., Brooklyn

Strainers, Pump Suction
Elliott Co., Jeannette, Pa.

Superheaters
Babcock & Wilcox Co., N. Y.
Foster Wheeler Corp., N. Y.
Power Plant Equipment Co., Kansas City, Mo.
Superheater Co., N. Y.

Switchboards
Westinghouse Elect. & Mfg. Co., Philadelphia

Switches & Circuit Breakers, Electric
General Electric Co., Schenectady

Tachometers
American Schaeffer & Budenberg Corp., Brooklyn
Biddle, James G., Phila.
Bristol Co., Waterbury
Coats Machine Tool Co., N. Y.
Foxboro Co., Foxboro
Leeds & Northrup Co., Phila.
Geo. Scherr Co., N. Y.
Zernickow Co., O., N. Y.

Tanks
Cochrane Corp., Phila.
Connery & Co., Philadelphia tanooga
Union Iron Works, Erie
Walsh & Weidner Boiler Co., Chat-Heine Boiler Co., N. Y.

Tanks, Copper
Hercules Float Wks., Springfield.

Tanks, Portable Oil
Bowser & Co., S. F., Ft. Wayne

Thermometers, Controlling, Indicating, Recording
Bailey Meter Co., Cleveland
Bristol Co., Waterbury
Foxboro Co., Foxboro
Leeds & Northrup Co., Phila.
Taylor Instrument Co.'s, Rochester

Thermometers, Flue Gas
American Schaeffer & Budenberg Corp., Brooklyn
Bailey Meter Co., Cleveland

Transformers
Allis-Chalmers Mfg. Co., Milwaukee

Transmission Machinery
(See Power Transmission Mach.)

Traps, Air, Grease, Non Return, Return, Radiator, Steam, Vacuum
American Schaeffer & Budenberg Corp., Brooklyn
Andrews-Bradshaw Co., Pittsburgh
Armstrong Mach. Works, Three Rivers, Mich.
Cochrane Corp., Phila.
Davis Regulator Co., G. M., Chicago
Ellis Drier Co., Chicago
Golden Anderson Valve Co., Specialty Co., Pittsburgh
Jenkins Bros., N. Y.
Johns-Manville Corp., N. Y.
Morehead Mfg. Co., Detroit
Nason Mfg. Co., N. Y.
Nicholson & Co., W. H., Wilkes-Barre
Powers Regulator Co., Chicago
Sarco Co., No., N. Y.
Schutte & Koerting, Phila.
Sterling Engr. & Mfg. Corp., Boston
Strong, Carlisle & Hammond Co., Cleveland
Swartwout Co., Cleveland
Templeton Steam Trap Co., N. Y.
Templeton Mfg. Co., Boston
Trerice Co., H. O., Chicago
Wright-Austin Co., N. Y.
Yarnall-Waring Co., Phila.

Traps, Superheated Steam
Armstrong Mach. Works, Three Rivers, Mich.

Tube Cleaners, Boiler
Chesterton Co., A. W., Boston
General Specialty Co., Buffalo
Lagonda Mfg. Co., Springfield, Ohio
Roto Co., Newark

Tube Cleaners Condenser
Lagonda Mfg. Co., Springfield, Ohio
Roto Co., Newark

Tube Cutters
Lagonda Mfg. Co., Springfield, Ohio

Tubes, Boiler
American Tube Bending Co., Niles
Boiler Tube Co. of America, Pittsburgh
Reading Iron Co., Reading
Tyler Tube & Pipe Co., Washington, Pa.

Tubes, Boiler, Charcoal Iron
Tyler Tube & Pipe Co., Washington.

Tubes, Boiler, Lap Welded
Tyler Tube & Pipe Co., Washington.

Tubes, Condenser
Foster Wheeler Corp., N. Y.
Scoville Mfg. Co., Waterbury

Tubing
Boiler Tube Co. of America, Pittsburgh
Scoville Mfg. Co., Waterbury

Tubing, Monel Metal
International Nickel Co., N. Y.

Turbines, Steam
Allis-Chalmers Mfg. Co. Milwaukee
Coppus Engineering Corp., Worcester
De Laval Steam Turbine Co., Trenton, N. J.
Elliott Co., Jeannette, Pa.
Moore Steam Turbine Corp., Wellsville, N. Y.
Murray Iron Wks. Co., Burlington
Sturtevant Co., B. F., Hyde Park
Terry Steam Turbine Co., Hartford
Westinghouse Elect. & Mfg. Co., Philadelphia

Turbines, Water
Allis-Chalmers Mfg. Co., Milwaukee

Turbo Generators
Elliott Co., Jeannette, Pa.
Terry Steam Turbine Co., Hartford

Unions and Union Fittings
Dart Mfg. Co., E. M., Providence
Jefferson Union Co., Lexington
Walworth Co., Boston

Valve Control, Electric
Pittsburgh (Pa.) Valve & Fdry. & Const. Co.

Valve Disk
Garlock Packing Co., Palmyra N. Y.
Jenkins Bros., N. Y.

Valve Reseating Machine
Leavitt Mach. Co., Orange, Mass.

Valves, Altitude
Golden Anderson Valve Specialty Co., Pittsburgh

Valves, Ammonia
Consolidated Ashcroft Hancock Co., Inc., N. Y.

Valves, Angle
Consolidated Ashcroft Hancock Co., Inc., N. Y.

Valves, Automatic Air
Sterling Engr. & Mfg. Corp., Boston
Templeton Mfg. Co., Boston

Valves, Automatic Cutoff
Elliott Co., Jeannette, Pa.
Golden Anderson Valve Specialty Co., Pittsburgh

Valves, Back Pressure
Cochrane Corp., Phila.
Davis Regulator Co., G. M., Chicago
Jenkins Bros., N. Y.

Valves Balanced
Davis Regulator Co., G. M., Chicago
Northern Equipment Co., Erie
Swartwout Co., Cleveland

Valves, Blowoff
Consolidated Ashcroft Hancock Co., Inc., N. Y.
Crosby Steam Gage & Valve Co., Boston
Eckenroth Valve & Mfg. Co., Phila.
Edward Valve Mfg. Co., East Chicago
Elliott Co., Jeannette, Pa.
Everlasting Valve Co., Jersey City
Homestead (Pa.) Valve Mfg. Co.
Jenkins Bros., N. Y.
Lunkenheimer Co., Cincinnati
Riley Power Equipment Co., Milwaukee
Templeton Steam Trap Co., N. Y.
Yarnall-Waring Co., Phila.

Valves, Brass and Iron Body
Consolidated Ashcroft Hancock Co., Inc., N. Y.
Golden Anderson Valve Specialty Co., Pittsburgh
Homestead (Pa.) Valve Mfg. Co.
Kennedy Valve Mfg. Co., Elmira
Lunkenheimer Co., Cincinnati
Pittsburgh (Pa.) Piping & Equip. Co.
Walworth Co., Boston

Valves, Bypass
Braun & Co., C. F., Alhambra
Consolidated Ashcroft Hancock Co., Inc., N. Y.
Jenkins Bros., N. Y.
Northern Equipment Co., Erie

Valves, Check
Cochrane Corp., Phila.
Consolidated Ashcroft Hancock Co., Inc., N. Y.
Davis Regulator Co., G. M., Chicago
Edward Valve Mfg. Co., East Chicago
Golden Anderson Valve Specialty Co., Pittsburgh
Greene, Tweed & Co., N. Y.
Jenkins Bros., N. Y.
Kennedy Valve Mfg. Co., Elmira
Lunkenheimer Co., Cincinnati

Valves, Coal Bin
Jeffrey Mfg. Co., Columbus

Valves, Electrically Operated
Edward Valve Mfg. Co., East Chicago
Golden-Anderson Valve Specialty Co., Pittsburgh
Pittsburgh (Pa.) Valve & Fdry. & Const. Co.

Valves, Exhaust Relief
Davis Regulator Co., G. M., Chicago
Edward Valve Mfg. Co., East Chicago
Wheeler Mfg. Co., C. H., Phila.

Valves, Float
Cochrane Corp., Phila.
Davis Regulator Co., G. M., Chicago
Golden-Anderson Valve Specialty Co., Pittsburgh
Northern Equipment Co., Erie
Yarnall-Waring Co., Phila.

Valves, Gate
Consolidated Ashcroft Hancock Co., Inc., N. Y.
Greene, Tweed & Co., N. Y.
Kennedy Valve Mfg. Co., Elmira
Lunkenheimer Co., Cincinnati
Pittsburgh (Pa.) Piping & Equip. Co.
Pittsburgh (Pa.) Valve & Fdry. & Const. Co.
Rockwell Co., W. S., N. Y.
Walworth Co., Boston
Wheeler Mfg. Co., C. H., Phila.

Valves, Globe
Consolidated Ashcroft Hancock Co., Inc., N. Y.
Crosby Steam Gage & Valve Co., Boston
Edward Valve Mfg. Co., East Chicago
Golden-Anderson Valve Specialty Co., Pittsburgh
Kennedy Valve Mfg. Co., Elmira
Lunkenheimer Co., Cincinnati
Strong, Carlisle & Hammond Co., Cleveland
Walworth Co., Boston

Valves, Hydraulic
Consolidated Ashcroft Hancock Co., Inc., N. Y.
Homestead (Pa.) Valve Mfg. Co.
Kennedy Valve Mfg. Co., Elmira
Swartwout Co., Cleveland
Vogt Machine Co., Henry, Louisville
Yarnall-Waring Co., Phila.

Valves, Monel Metal
International Nickel Co., N. Y.

Valves, Non-Return Stop
Elliott Co., Jeannette, Pa.
Edward Valve Mfg. Co., East Chicago
Golden-Anderson Valve Specialty Co., Pittsburgh
Strong, Carlisle & Hammond Co., Cleveland

Valves, Pop, Safety
Consolidated Ashcroft Hancock Co., Inc., N. Y.

Valves, Pump
Crandall Packing Co. Palmyra
Durabla Mfg. Co., N. Y.

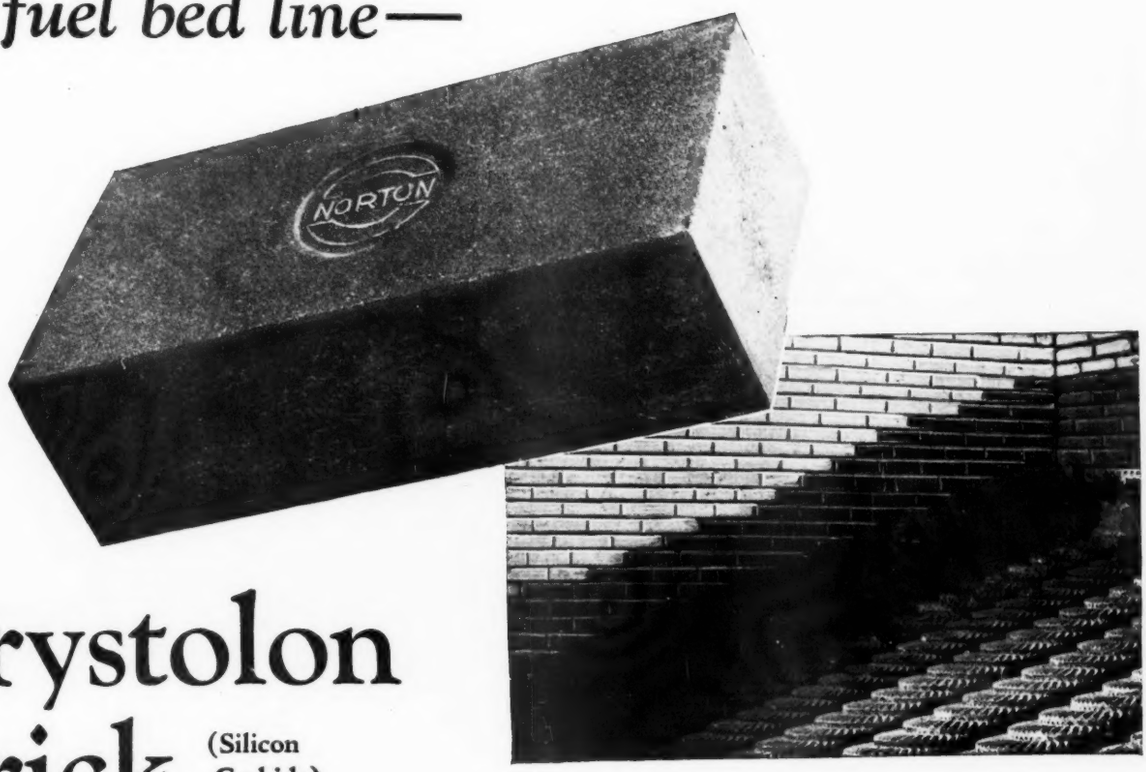
Valves, Pump Rubber
Garlock Packing Co., Palmyra, N. Y.
Jenkins Bros., N. Y.

Valves, Radiator Control
Johns-Manville Corp., N. Y.

Valves, Reducing
Davis Regulator Co., G. M., Chicago
Golden Anderson Valve Specialty Co., Pittsburgh
Mason Regulator Co., Boston
Northern Equipment Co., Erie
Swartwout Co., Cleveland
Templeton Steam Trap Co., N. Y.

Valves, Regrinding
Consolidated Ashcroft Hancock Co., Inc., N. Y.

Carry them up above the fuel bed line—



Crystolon Brick (Silicon Carbide)

Lay them where the wear is the hardest—where the natural softness of fire clay brick causes rapid wear by fuel bed abrasion. Crystolon Brick are hard enough to withstand the severest fuel abrasion for long periods of operation.

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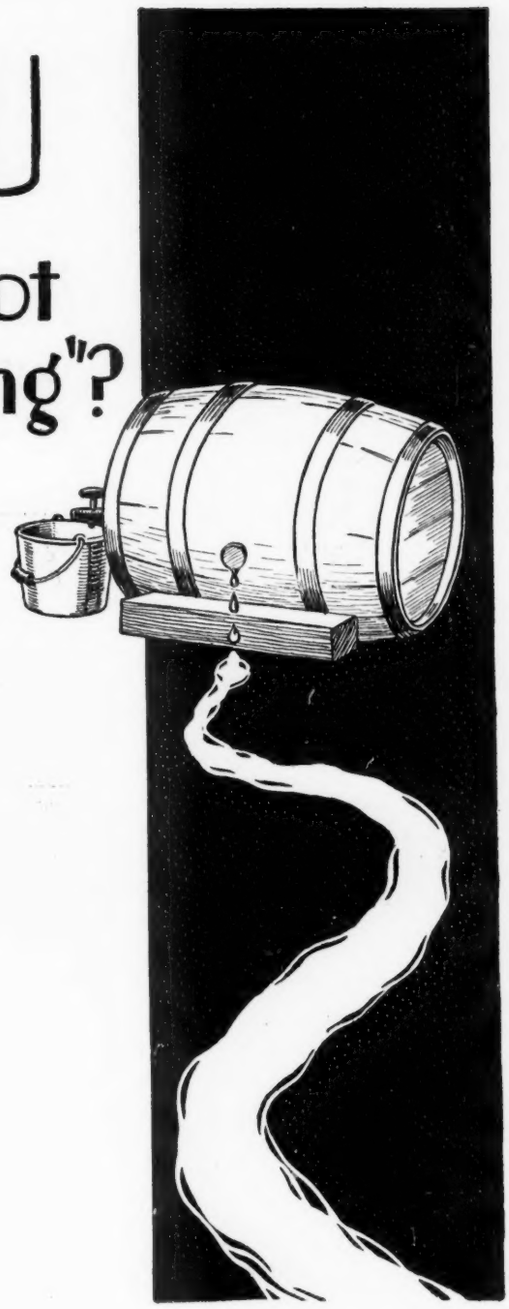

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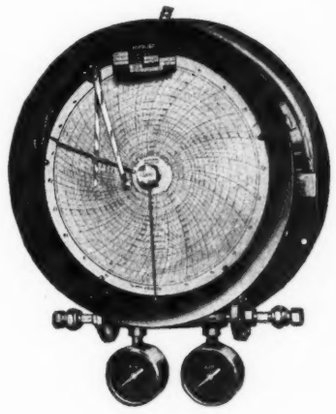

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